NATIONAL PETROLEUM NEWS

November 3, 1943

TECHNOLOGY DEPT.

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WAR PRODUCTION BOARD

WASHINGTON, D. C.

To the Petroleum Industry:

The Petroleum Industry has already contributed hundreds of thousands of tons of iron and steel scrap and co-operated fully with the Industrial Salvage Branch in past salvage programs. The need for more scrap is urgent. Let me indicate it to you in this way -- new theaters of war are opening up and our offensive drives are gaining momentum. This calls for increased production of planes, tanks, guns, ships, and ammunition, and half of every tank, gun, and ship is made from iron and steel scrap.

Speaking broadly, our requirements for 1943 are as follows:

Airplanes -- double in number and four times in weight over 1942.

Ships -- double in tonnage over 1942 -- more than 19,000,000 tons.

Naval craft -- double in tonnage.

Munitions -- generally -- double 1942.

As an indication of increased demand for iron and steel scrap, requirements for the last half of this year have been set at 15,000,000 tons. Industrial salvage is looked to for 9.8 million tons, or 65% of this total. This amount of scrap will only maintain, not increase, steel production. It is a goal that we must attain in order to insure continued steel production at peak level.

Every petroleum company shares in the responsibility of maintaining and increasing the flow of this vital scrap iron and steel. We urgently need your scrap now.

Have your top Salvage Executives and Committees --

1. Resurvey all plants and properties for dormant scrap.
2. Prepare a new list of all idle and obsolete equipment.
3. Dispose immediately of all free and unquestionable items.
4. Study all questionable, idle and obsolete items for future disposition.

The need for scrap will continue so long as the war lasts. We suggest that your salvage program be on a continuing basis for the duration.

John J. Sheehan

John J. Sheehan, Chief
Industrial Salvage Branch
Salvage Division

What do fighters think about?

DREAMS that include the better things in life spur our fighters on. Fighters all have their secret aspirations —so have men in industry. Our post-war dreams at Erie Meters have substance, for they are based on tangible efforts to plan for post-war. Recently we conducted a nation-wide contest among thousands of men in the petroleum industry. Hundreds of personal interviews are further supporting our ideas for new post-war products. We were all totally unprepared for war but none of us need be unprepared for peace.

Official United States Army Signal Corps, U. S. Marine and U. S. Navy photos

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Refinery Group Shares Honors with Bomber Crew at Ashton Rally

By Herb Taylor
NPN Staff Writer

ANOTHER chapter was written in the long and successful career of general manager H. T. (Ash) Ashton, Lubrite Division, Socony-Vacuum, on Oct. 12 when the combat bomber "Old Hell Cat" and its intrepid young crew visited Socony-Vac's East St. Louis refinery.

Under Mr. Ashton's direction, the visit of the crew of the "Old Hell Cat", on a tour of refineries where new units for producing 100-octane gasoline are being installed, served a two-fold purpose.

It resulted in a better understanding on the part of refinery workers as to their vital importance in the production of gasoline on the home front for the fighters on the war front. It also gave the crew of the B-26 Marauder a story to tell their fellow fighters about oil's war effort in the U. S.

Refinery workers and construction men, 1200 strong, heard Capt. Lloyd, 22 years old, tell of the tremendous role that 100-octane gasoline plays in the success of each bombing mission and of the vital importance of an unfailing flow of the fuel to air bases in every theater of operation and combat.

From every vantage point within hearing distance of the speakers' platform these refinery workers and construction men heard Mr. Ashton pay tribute to the airmen for their courage and bravery on the fighting fronts of Tunisia and Sicily. But these workers—laborers, stillmen, bosses, laboratory workers, clerks, drivers and the dozens of other classifications making up a refinery crew—learned also of their own importance in the picture.

Youthful members of the crew of the B-26 Marauder "Old Hell Cat," are greeted at Scott Field, Ill., just before their visit to the Socony-Vacuum refinery at East St. Louis. Veterans of 50 bombing missions in North Africa and Sicily the intrepid airmen gave refinery workers first hand information on the vital role of aviation gasoline in clearing the enemy from the Mediterranean area

"This is a war plant; it is a war-vital plant. Every air victory which we have won on the battle front has been won with 100 octane gasoline", the workers were told by Mr. Ashton. He pointed out that our gigantic and growing air force is useless without the proper fuel to fly it; that the war can be won or lost with 100 octane gasoline.

Mr. Ashton told his men and women that since June of this year his plant had shipped a quantity of finished 100 octane gasoline sufficient to bomb the Ruhr Valley from England with 100 Flying Fortresses 3½ times each month. These shipments, he said, will continue, and with the completion of the new facilities in the plant, scheduled for the near future, we will ship monthly sufficient 100 octane gasoline to bomb the Ruhr Valley from England with 1000 Flying Fortresses 7 times every month.

Back of the visit of the crew of the "Old Hell Cat" bringing greetings from men on the fighting front to the construction workers and operators of the Socony-Vacuum refinery is a story of

(*Continued on p.* 48)

Socony-Vacuum workers listened with pride as H. T. Ashton, manager of the Lubrite division, pledged that an ever increasing volume of high octane would be produced for American airmen on the fighting fronts. Left, a closeup of Mr. Ashton at the microphone

★

Maston Nixon . . .

New President of Texas Mid-Continent Oil & Gas Assn.

★

NEWLY elected president of the Texas Mid-Continent Oil and Gas Assn. is Maston Nixon, a familiar figure to members of the industry in and out of Texas.

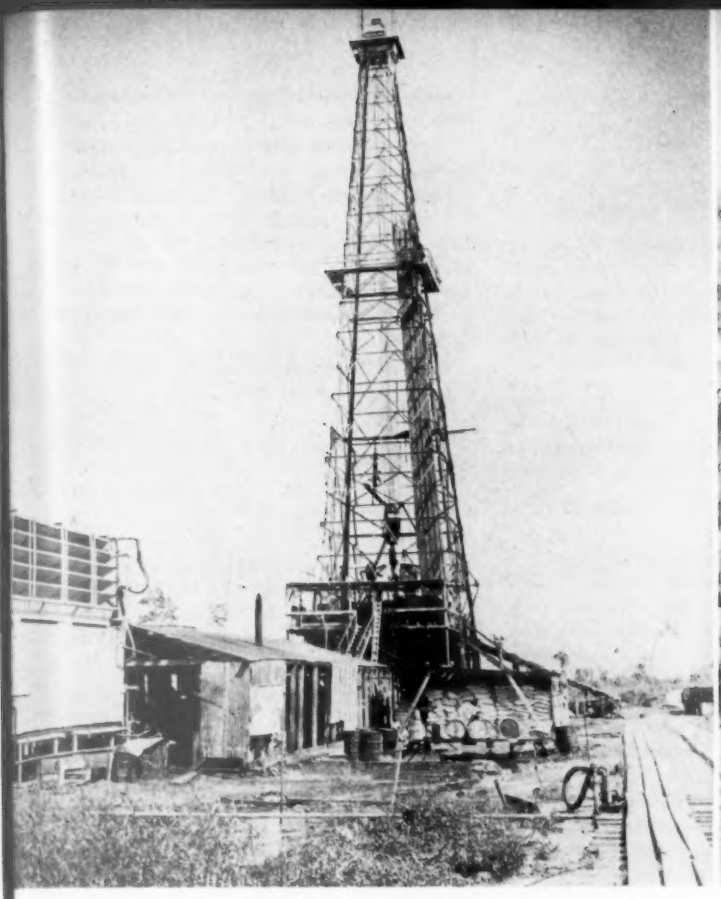
Mr. Nixon is vice-president in charge of operations for Southern Minerals Corp., Southern Pipe Line Corp., and Southern Condensate Corp. He is chairman of both the crude oil supply subcommittee and the coastwise and inland waterways subcommittee of District 3. He is also a member of the District 3 Transportation committee.

While "home" today to Mr. Nixon is Corpus Christi, Tex., he was born in Luling, Tex., 47 years ago. He attended San Antonio Academy, was graduated at the age of 16 and immediately entered the business world.

The entry of the U. S. into World War 1 found young Mr. Nixon attending First Officers Training Camp at Leon Springs, Tex. He was commissioned a first lieutenant in 1917, just 7 months after he had come of age. At the age of 22 he was made a captain of Field Artillery. In France, Capt. Nixon commanded Battery F, 334th Field Artillery. He later served with the Army of Occupation in Germany.

NATIONAL PETROLEUM NEWS—Nov. 3, 1943—Vol. XXXV—No. 44. Published every week at 1213 West 3rd St., Cleveland 13, Ohio, U.S.A. Subscription rate $5.00 per year in United States, Mexico, and Pan-American countries; $6.50 Canada and foreign countries. Entered as second class matter Jan. 17, 1910 at Cleveland, O., post office under act of March 3, 1879, by The National Petroleum Publishing Co. Copyright 1943 The National Petroleum Publishing Company.

NATIONAL PETROLEUM NEWS
NOVEMBER 3, 1943
VOL. 35 · · · Nº 44



Here is the derrick that marks the site of the Humble Oil Co.'s history-making Sunniland No. 1 oil well in the heart of Florida's Everglades. At the right, J. L. Crump looks on as one of the drillers removes a sample for experimental purposes

Experts and Scoffers Alike Jolted by Oil Strike in Everglades

Special to NPN

MIAMI, Fla.—Many have scoffed and experts have been highly skeptical, but early in October the Humble Oil Co. obtained the first definite indication of oil in the state of Florida at their Sunniland No. 1 well, located in Collier county deep in the heart of the Everglades. By the end of the month, tests indicated about 30% crude oil in the salt water mixture being removed from the 11,627-ft. hole.

Oil exploration has been carried on in the Everglades—a semi-aqueous area of many hundred square miles covering the interior of South Florida below Lake Okechobee—for more than 20 years. Much of the earlier efforts had been brushed with the taint of real estate promotion. The public tended to discount the seriousness of oil exploration, even after reputable companies became interested and began sinking wells.

Future Holds Fate

Whether the Sunniland well is to produce oil in commercial quantities is a matter for the future. In commenting on the possibility, John B. Payne, in charge of Humble operations, declared: "I don't know whether the present percentage is sufficient in this deep a well for commercial purposes or not. We are now trying to stop the inflow of water in order to make further tests."

Drilling is under contract to Loftin Bros. of Tulsa. Clyde Long is superintendent.

From 400 to 500 barrels of crude had been taken from the well at an early date and stored in 1000 barrel tanks erected hurriedly to receive the surprise discovery.

Drilling at Sunniland was begun on March 1. Some 6 months later the well made its first showing of oil at 10,000 feet. After exhaustive tests by Humble geologists and production men, it was decided that the well must go deeper.

On Oct. 14 a showing of oil was made sufficient to cause oil company officials to announce they had a producing well. During the course of swabbing operations, some 1300 gallons of fluid comprising an oil and salt water emulsion was removed, from which was recovered approximately 500 barrels of oil.

The lease under which Humble is operating is said to be the largest single oil lease in the U. S. It includes 1,064,220 acres of land in Lee, Collier and Hendry counties.

Another lease owned by Humble includes 105,000 acres in Dade county. Other Dade county leases are owned by local concerns—14,000 acres to the Cracker Oil Co. of Fort Lauderdale and 4900 acres owned by the Consumers Oil & Gas Co. of Miami.

An old-time Texas oil promoter, Neil Scroggins, sank the first well in the South Florida area in 1925 when the state was in the throes of its original boomtime development. He drilled a well 42 miles west of Miami at the Dade-Monroe county line.

Give Up at 4500 Feet

Scroggins abandoned the enterprise when he reached 2200 feet, and men who followed him continued it to a depth of 4560 feet, without success.

During this period, other test wells were being drilled in various parts of the peninsula. South of Miami the Kendall experimental well was sunk to 4300 feet; a 2000 foot well was drilled at Florida City, almost at the southern tip of the state. A well at DeFuniak Springs, in the northern part of the state, was reported recently to have passed the 6000 foot mark.

The search for oil in Florida's Everglades presents many situations not to be encountered in any other section of the globe.

NEW WARTIME EDITION

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Administration Says 'No' to Crude Rise; Proponents Map Fight in Congress

By James Collins
NPN Staff Writer

WASHINGTON — The White House slammed shut the door this week on a general crude oil price increase except by any other than the questionable and hazardous legislative route.

With finality, Economic Stabilizer Vinson denied the American oil industry's 2-year plea for price relief and ordered instead the devisement of subsidy and other incentives for the drilling of wildcat wells, development of new fields and the stimulation, if feasible, of marginal stripper wells and secondary recovery operations.

"To keep faith with the unnumbered millions of wage earners, producers and merchants whose wages and prices have been stabilized," Judge Vinson ruled, "no increase can be granted in the price of crude oil in light of the other practical measures available to insure an adequate supply of petroleum."

PAW Gets 'Hot Potato'

To PAW, in partnership with PIWC, the Judge tossed the hot potato of devising a "selective incentive program" for increasing this country's crude oil productive capacity.

With price out of the window as a possibility, Vinson said he entertained "no doubt whatsoever of the ability of the PAW in cooperation with the Petroleum Industry War Council to devise a practical, workable program for giving additional financial support to exploratory activity and development of new fields without increasing the cost of living, burdening government or business with an impossible administrative task, or dispensing public funds to those not engaged in exploratory activity or development of new fields."

As for marginal wells and secondary recovery projects, "it may be feasible," he said, "to provide additional financial support short of a general price increase. If so, such support should be extended."

Thus, back in the lap of PAW Ickes went the question of finally resolving the issue he himself raised last April 7; only this time he is under what amounts to a White House mandate to go the OPA subsidy route, like it or not.

Capitol Hill Erupts

And whether PAW Ickes likes it or not, Congress definitely doesn't.

Capitol Hill reaction to Vinson's decision was violent. Sharp criticism came from both houses of Congress.

Oil state congressmen, however, were most voluble in expressing their feelings, with the most outspoken remarks coming from Rep. Disney, Okla., congressional wheel-horse on the crude price issue. Said Mr. Disney:

"The independent oil men of this country owe this Administration vengeance, and they are going to work on it. Talk about appeasement at Munich! This action on crude prices is the greatest anti-business appeasement there ever was. We will have to marshal our forces and force price legislation through Congress. They (the Administration) may lick us, but we are going to do our damndest."

A hint as to the legislative route the crude price question may travel through Congress was provided in this remark by Sen. Thomas, Okla.:

"The only way to increase crude prices is to attach a 'rider' to some 'must' bill the Administration wants passed. That's what the milk people may do, and we may join hands with them and ride it through that way. If it doesn't work, we're helpless."

'Should Stress Inequality'

Rep. Lea, Calif., chairman of the special House oil investigating committee, expressed the opinion that too much emphasis has been placed on a crude price increase to stimulate wildcatting and not enough on the fact that the price of oil is not fair or equitable. He also told NPN that he was trying to round up members of the committee so that hearings could be resumed on Thursday, Nov. 4, to take further testimony from PAW Ickes and his deputy, Ralph K. Davies. Undoubtedly, the questioning will swing around to the "incentive" scheme tossed at Ickes by Vinson and what he plans to do about it.

As for the attitude of industry, PIWC Chairman Boyd warned ominously that if the fear of a future shortage of crude supply should prove well founded, the industry and PAW cannot be blamed. Although Mr. Boyd merely said Vinson's decision will be reviewed and discussed by PIWC at its next meeting called for Nov. 8-9 in Chicago, there was every indication that the price issue would flare up and spread not only at PIWC meetings but at those of the A.P.I. which holds its annual meeting in Chicago next week also.

Here are just a sprinkling of other comments by Senate and House members:

Rep. Johnson, Okla.: "Although Vinson is a fine judge, there is no one I know of who knows less about oil. All he knows is what somebody tells him. The only thing to do is to take the bull by the horns and force a bill through Congress."

Sen. Reed, Kans. "You couldn't take my views and print them; they wouldn't get through the mails in your magazine. They're going to have a pretty tough job forcing a subsidy down the throat of the oil industry which doesn't want any part of it."

Rep. Harris, Ark. (member of Lea committee): "If there's any business which hasn't been given a fair price adjustment, it's certainly oil. Materials and labor costs have gone up . . . I am definitely opposed to a subsidy idea which would be almost impossible to administer."

Sen. Moore, Okla.: "It must have been apparent that the making of a close question out of this price for crude oil was just a kind of cheap shadow-boxing . . . The oil industry produced abundant evidence (for a price increase) . . . If there could have been anything more done than has been done to create hindrances, obstructions, and confusion among oil producers, I would not know what it could be. Many oil producers will be bankrupted."

Instructs Ickes on Program

In the following words, Judge Vinson outlined to PAW Ickes the kind of a program that will be acceptable to the White House; a program as to the acceptability of which he will be the final arbiter:

"The Petroleum Administrator is directed to formulate without delay a program to provide additional financial incentives for exploration and development of new fields in conformity with the standards outlined . . . and if feasible, additional financial support for marginal stripper well and repressuring operations short of a general price increase.

"On formulation of selective incentive

Oilgram Readers Had Text Monday Morning

Just a few minutes before Oilgram's deadline last Friday, Bureau Chief Yocom flashed word from Washington that Economic Stabilizer Vinson had at last made a decision on wide-spread requests for an increase in the price of crude oil.

Had he approved or disapproved? Mr. Yocom was able to flash OILGRAM readers that the increase had been turned down, although Mr. Vinson's office had insisted that the decision was not to be released until 9 p.m. that night.

OILGRAM and NPN's staff then had a decision of their own to make. They felt that executives of the oil industry not only would want to know what the answer was but also what Mr. Vinson's reasons were. How could they get it to them?

News Editor Weston had the answer: "Let's say on the bottom of the bulletin that OILGRAM will get out a special edition tomorrow containing the complete text. Then it will be on every oil executive's desk Monday morning."

It was done and NPN's Washington staff made sure that a copy of the decision was airmailed to Cleveland to be ready for the girls who cut the stencils the first thing Saturday morning.

The rest is history. The girls worked steadily until noon and when they had finished a 10-page special OILGRAM was ready for the mails.

It was another example of how OILGRAM and NPN do their best to serve the oil industry.

programs by the Petroleum Administrator consistent with the stabilization program," he added, "the Economic Stabilization Director will direct execution of the programs by such other agencies as may be concerned."

As to the governing principles by which Mr. Ickes is to be guided in carrying out the Vinson dictum, they were laid out by the economic chieftain as follows:

"(1) **To be avoided is any increase** in the cost of living. This principle presupposes that the financial support for an increased exploratory and development program and for continuation of marginal production which cannot be absorbed by other segments of the industry must come from public funds. Since the necessity for increasing oil production by higher cost operations is entirely the result of military demands it is only proper that the added cost of producing this additional oil should be borne as a war cost by the Government.

"Congress has approved this principle in the Emergency Price Control Act of 1942, authorizing use of public funds to provide additional incentives for increased production. It may be added that subsidies are not new to the oil industry. Traditionally the wildcatters have been subsidized by major companies through payment of 'dry hole' or 'deep hole' money and countless other devices. Because of the war assistance beyond that which the major companies can give may be required. Only by this method as contrasted with a general price increase can an increase in immediate living costs be prevented while at the same time high cost production is made profitable.

"(2) **To be avoided is any complex scheme** for subsidy payments subjecting agencies of Government and the oil industry to impossible administrative burdens, or for that matter any program that invites suspicion by the oil industry that any effort is being made by any Government agency to supplant the industry. This latter bogeyman will not in my opinion be difficult to elude for it is no more than the product of overactive imagination.

"(3) **To be avoided is any program** that rewards without discrimination those who engage in exploratory activity and the development of new fields and those who do neither. This principle was enunciated in somewhat different context by the Secretary of the Interior in expressing opposition to Senate Bill 2239, 77th Congress, 2nd Session, which provided in an amended form for a blanket reduction in royalty rate for oil produced from new fields in the public domain. In expressing opposition to the bill in this form the Secretary observed, 'Thus, the Bill would reward those who are not entitled thereto equally with the pioneer who made the initial discovery of a new oil and gas field.'

"At the Secretary's instance the Bill was revised so as only to reward the one who discovered the new field. In connection with this Bill the Secretary and Congress thought it feasible to distinguish between new fields and old fields and as well between those who discover new fields and those who don't. So here in providing financial support for exploratory activity and the development of new fields additional rewards should be limited to those who engaged in those activities. Likewise, and to the extent feasible, any additional incentives for initiation of secondary recovery projects and prolonged operation of marginal stripper wells should be limited to those who engage in those activities. Such a limitation will not only minimize the cost of the program but will as well tend to insure affirmative efforts to increase the nation's crude oil productive capacity."

Adopt measures that conform to the above general standards, and make full use of Texas oil and of foreign crude, and "it is clear," concluded Mr. Vinson, "That an adequate supply of oil for military and essential civilian needs can be maintained without the obvious and serious disadvantages of a general increase in the price of all crude oil. Apart from the stabilization program, it is believed adoption of the alternative would be dictated. The stabilization program permits of no other decision."

In rejecting the general price increase method, Mr. Vinson made much of the fact—readily admitted by PAW—that the effect of an increase "would not be felt in substantially increased completions of exploratory wells for a year or two."

"Even then, however," he continued, "There would be no assurance that in-

(*Continued on p. 41*)

Disappointed Industry Turns to Congress

NPN News Bureau

CLEVELAND—The oil industry this week was pinning its hopes on Congress to do something about crude oil prices. The Administration's flat "No" meant the blocking of only one avenue of relief.

Reaction to the Vinson turndown was the same all over, but oil spokesmen expressed it in different ways. Bill Boyd's public statement mentioned "keen disappointment". Terms more warmly descriptive of feelings were voiced privately in many other quarters.

"Makes me so mad I don't even want to talk about it," exploded one Oklahoma refiner.

In Texas, J. D. Sandefer, Jr., newly-elected president of the National Stripper Well Assn., declared: "We have been knocked down so many times in this matter it was not a new experience for the owners of the stripper wells to get it again.

'Noose Grows Tighter'

"It is beyond human conception how a limited few can continue to ram down the throats of the American people this absurd injustice. . . . The noose around our necks is so tight that we are gasping for breath and only a price rise in crude oil can save us."

Also in Texas, H. P. Nichols, executive vice-president of the East Texas Oil Assn., warned that the Administration's action "endangers the war effort", and President Little of Magnolia Petroleum Co. commented: "The price of petroleum should be increased in line with the prices of other commodities. . . . Petroleum industry prices were frozen at a level so low that we cannot replace the oil we are using at the prices we are getting for it."

Another Texas major oil company executive said: 'The action will tend to make the oil industry lean more toward government financial aid. I guess that's what the boys in Washington want."

Texas Railroad Commissioner Culberson said the low crude prices are "a deplorable result of the monopolistic situation that exists in that major refinery purchasers . . . have refused to raise the price . . . since 1936 when its cost of production began advancing out of proportion to other commodities."

'Will Continue Fight'

Commission Chairman Beauford Jester asserted: "We will continue to fight for an oil price increase. We concur with Abe Lincoln's statement to the effect that no issue is settled until it is settled right." Vinson's denial is a shortsighted economic policy, he said.

California oil men felt this way: "We have told our story. We have given the government and the people the facts and figures of what is happening in the oil business. There is not much more anyone can do, except let time prove the inevitable critical shortage which might have been avoided by intelligent price action."

One California oil company executive said that had a 35c to 50c per bbl. increase in crude been granted, production in California would have been increased 60,000 to 100,000 b/d within a year. This would have been obtained by drilling of thousands of acres of marginal land in the state, he said, adding that present prices will not return the cost of such drilling.

Gill's Views on Price

Chairman John Gill of PIWC's cost and price adjustment committee had already expressed his opinion in these words: "The government's failure to approve . . . (a price increase) . . . may prove to be the most significant economic fact of the war period."

Meantime, Gov. Coke Stevenson of Texas had made a trip to see Vinson about crude prices. Returning, he reported that Vinson had refused to see him, that he was given an appointment with a minor OPA official, that he had waited 50 minutes to see the official, and that he had finally left without seeing him.

I.P.A.A. and Stripper Operators to Enlist Governors in Fight for Boost in Crude

By Special Correspondent

FORT WORTH, Tex. — A move to enlist aid of the 48 governors in the fight for an increase in the price of crude oil was initiated here by the Independent Petroleum Assn. of America, which met jointly Oct. 25-27 with the National Stripper Well Assn.

Governors of 3 of the nation's largest oil producing states pledged their help in making governors of non-producing states see that the problem is theirs, too.

At the same time, the independents urged the government to require segregation of earnings reports of major oil companies, which, the independents assert, will show that production is not standing on its own feet even for the majors and that these companies are holding their own through refining, marketing and transportation profits.

Governors here for the session were John J. Dempsey, New Mexico, Andrew Schoeppel, Kansas, and Coke R. Stevenson, Texas. Robert S. Kerr, Oklahoma, was represented by W. J. Holloway, a former governor.

After the oil convention, Gov. Stevenson left for Washington, decling to say what his mission was but leaving the impression that he might be carrying the oil men's message to administration leaders.

Non-Producers' Problem, Too

Dempsey said oil men must remember there are more non-oil producing states than there are producers.

"Three non oil-producers are interested in one thing—to get sufficient gasoline and fuel for their people," he said. "It is the duty of oil men to let them know that under the present program they are going to get less gasoline—not more.

"Tell them that because of the low price of crude oil, independents can't go out and look for more fields. When they find out the only way to get more gasoline is through a higher crude price, you will get the price rise."

The governors tacitly agreed that war time regimentation must be endured, but that oil men must fight after the war for elimination of bureaus that act as "prosecuting attorney, judge and jury."

Gov. Schoeppel condemned as "dastardly" the charge that oil men are cutting back production because they are producing at a loss." He said he know it to be untrue.

Cite Losses in Production

The resolution calling for reports on profits from all branches of operations by oil companies was viewed as far reaching.

Independents believe they can show the government that production is not paying its own way.

Likewise important was a resolution asking the War Manpower Commission to designate the petroleum equipment supply industry as essential.

The stripper well association men also adopted a resolution asking that their men be classed as essential to the war effort, pointing out that inexperienced men could mismanage a producer and destroy its utility for all time.

Their voice, too, was added to the price hike plea, their resolution urging that production be put on a parity with other products.

The strippers studiously avoided discussion of the recent OPA offer of a subsidy in lieu of a price increase.

J. D. Sandefer Jr. of Breckenridge, Tex., was elected president of the N.S.A. to succeed C. P. McGaha of Wichita Falls.

The I.P.A.A. elected Ralph T. Zook of Bradford, Pa., as president to succeed Frank Buttram of Oklahoma City, who stepped aside after serving 4 terms.

Hits at Subsidy

Mr. Buttram hit at the subsidy by inference in his address at the meeting when he declared:

"As an alternative to a crude price increase, we will accept no temporary palliative, no sop, no complicated, unwieldy and unworkable subsidy, rollback, bonus or other compromise with what is fair, open and workable.

"We have not neared the end of our fight. Our chief weapon is truth, and we will keep right on using it."

Russell B. Brown of Washington, general counsel for the I.P.A.A., said he believed Congress would take out of the hands of the executive branch the question of granting a price hike.

He expressed regret at the government's entrance into the oil business on a competitive basis and urged that a protest be made against the government's Petroleum Reserves Corp. for "actively engaging in competition with our independent producers."

Texas Railroad Commissioner Thompson spoke on United States and World Crude Oil Reserves and Their Availability.

Sights Worse Shortage

He predicted further reduction in the value of gasoline ration coupons after Jan. 1.

"We are producing at the all-time high of 4,600,000 b/d, and cannot long maintain this high rate without new discoveries," he said.

W. A. Delaney, Jr., of Ada, Okla., who attacked 95 boards, agencies and bureaus as crippling business in the U. S., said the number of wildcat wells necessary to maintain reserves cannot be drilled under present price regulations.

Other speakers included D. T. Andrus, president of the Pennsylvania Grade Crude Oil Assn.; H. M. McClure, Michigan Oil and Gas Assn; C. E. Buchner, executive manager of the I.P.A.A.; W. T. Knight, Wichita Falls independent; Wirt Franklin, special PAW field assistant; and Maj. Gen. Richard Donovan, commanding general of the 8th Service Command at Dallas.

The stripper association, in addition to Mr. Sandefer, elected H. B. Fell of Ardmore, Okla., as executive vice-president, Howard J. Whitehill, Tulsa, secretary-treasurer.

In the I.P.A.A. election, Minnesota got its first representation through a vice-president when Thomas A. Jirik of Fairbault was elected.

J. D. Sandefer, Jr., of Breckenridge, Tex., at right, the new president of the National Stripper Well Assn., and C. P. McGaha of Wichita Falls, left, whom he succeeded at the Fort Worth convention

H. A. Becker
Universal Oil

N. K. Anderson
Universal Oil

C. V. Hornberg
Socony-Vacuum

Harry Levin
The Texas Co.

Jerry McAfee
Universal Oil

M. S. Northup
N. J. Standard

J. F. M. Taylor
Shell Oil Co.

C. L. Thomas
Universal Oil

Final Program of 24th Annual Meeting Of American Petroleum Institute

Following is the final program of the American Petroleum Institute's 24th annual meeting, to be held Nov. 8 to 11 at the Palmer House in Chicago. Committee meetings are not listed, but these will be held throughout the week beginning Friday, Nov. 5, through Thursday, Nov. 11.

Registration and information desk will be in the foyer of the grand ballroom.

GROUP SESSIONS
Protection of Petroleum Facilities

Tuesday, November 9, 1943

10:00 A.M.

Wartime Facility Security:

Presiding: George A. Hill, Jr., Chairman, PIWC Committee on Protection of Petroleum Facilities; Houston Oil Co. of Texas, Houston, Texas.

Wartime Instruction and Training of Employees.

L. S. Wescoat, Chairman, PIWC Great Lakes Region Committee on Protection of Petroleum Facilities, Chicago, Ill.

Wartime Fire Protection.

A. A. Jergins, Petroleum Administration for War, Washington, D. C.

Wartime Protection of Petroleum Piers and Wharves.

Captain Norman B. Hall, U. S. Coast Guard, Washington, D. C.

Coordinating Wartime Internal-Security Programs.

Colonel George K. Engelhart, Provost Marshal General's Office, Washington, D. C.

Division of Refining

Tuesday, November 9, 1943

1:30 P.M.

Wartime Cooperation:

Presiding: G. G. Oberfell, Phillips Petroleum Co., Bartlesville, Okla.

Technological Team Work.

T. G. Delbridge, Chairman, PIWC Technical Advisory Committee; The Atlantic Refining Co., Philadelphia, Pa.

Cracking-Coil Tubes at War — They Can Take It!

P. J. Harrington, M. S. Northup, and C. O. Rhys, Sr., Standard Oil Development Co., Elizabeth, N. J.

The Analytical Chemist on the Spot.

Harry Levin, Chairman, PIWC TAC Subcommittee on Analytical Methods, The Texas Co., Beacon, N. Y.

The Activities of the Aviation-Gasoline Advisory Committee.

H. G. Burks, Jr., Chairman, PAW Aviation-Gasoline Advisory Committee; Standard Oil Co. of New Jersey, New York, N. Y.

Oiling the War Machine.

G. R. Lord, Chairman, PAW Lubricating-Oil Advisory Committee, Sinclair Refining Co., New York, N. Y.

The Coordinating Research Council.

K. G. Mackenzie, Chairman, Automotive Research Committee; The Texas Co., New York, N. Y.

Wednesday, November 10, 1943

9:30 A.M.

Research Reports and Catalytic Cracking:

Presiding: J. F. M. Taylor, Shell Oil Co., Inc., New York, N. Y.

Hydrocarbons in the Gasoline Fraction of Seven Representative Crudes.

A. F. Forziati, C. B. Willingham, B. J. Mair, and F. D. Rossini, National Bureau of Standards, Washington, D. C.

The Synthesis and Properties of Hydrocarbons of High Molecular Weight—III.

R. W. Schiessler, D. G. Clarke, C. S. Rowland, W. S. Sloatman, and C. H. Herr, The Pennsylvania State College, State College, Pa.

Houdry Adiabatic Process for the Conversion of Petroleum Hydrocarbons.

Eugene J. Houdry, Houdry Process Corp., Wilmington, Del.

Cracking with Catalysts.

C. L. Thomas, N. K. Anderson, H. A. Becker, and J. McAfee, Universal Oil Products Co., Chicago, Ill.

Thursday, November 11, 1943

9:30 A.M.

Catalytic Cracking:

Presiding: W. B. Ross, The Pure Oil Co., Chicago, Ill.

Gas-Oil Cracking by the Cycloversion Process.

W. A. Schulze and C. J. Helmers, Phillips Petroleum Co., Bartlesville, Okla.

Recent Developments in TCC Processing.

T. P. Simpson, J. W. Payne, L. P. Evans, and C. V. Hornberg, Socony-Vacuum Oil Co., Inc., Paulsboro, N. J.

New Houdry Static-Bed Developments.

R. H. Newton and T. B. Prickett, Houdry Process Corp., Wilmington, Del.

Fluid-Catalyst Cracking for Premium Fuels.

E. V. Murphree, H. G. M. Fischer, E. J. Gohr, and W. J. Sweeney, Standard Oil Development Co., Elizabeth, N. J.; and C. L. Brown, Standard Oil Co. of Louisiana, Baton Rouge, La.

Report of Division's Nominating Committee.

J. T. McCoy, Tide Water Associated Oil Co., Bayonne, N. J., Chairman.

Election of Twenty Members of the General Committee of the Division of Refining.

Division of Production

Tuesday, November 9, 1943

2:00 P.M.

Internal Corrosion of Products Pipe Lines:

(Sponsored by the Topical Committee on Pipe-Line Technology)

Presiding: A. H. Riney, Phillips Petroleum Co., Bartlesville, Okla., and W. F. Rogers, Gulf Oil Corp., Houston, Texas.

Suggested Formula for Calculating Capacity of Products Lines.

T. R. Aude, Stanolind Pipe Line Co., Tulsa, Okla.

Symposium on Combating Internal Corrosion of Products Pipe Lines.

Tuesday, November 9, 1943

2:00 P.M.

Determination of Oil Fields' Susceptibility to Secondary Recovery:

(Sponsored by the Central Committee on Drilling and Production Practice)

Presiding: Paul D. Torrey, Consulting Engineer, Houston, Texas, and George H. Fancher, University of Texas, Austin, Texas.

Part I: Schedule of Information Desirable for a Study of the Secondary-Recovery Possibilities of an Oil Field.

Paul D. Torrey, Consulting Engineer, Houston, Texas.

Part II: Analysis of Field Information and Discussion of Criteria Determining the Probability of Success of Secondary-Recovery Operations.

P. J. Harrington
N. J. Standard

C. J. Helmers
Phillips

G. R. Lord
Sinclair Refining

J. T. McCoy
Tide Water

C. B. Willingham
B. of Stds.

B. J. Mair
B. of Stds.

W. J. Sweeney
N. J. Standard

Edgar Kraus
Atlantic

B. E. Hull
W. E. P.

S. E. Buckley
Humble Oil

C. L. Brown
La. Standard

T. R. Aude
Stanolind

C. J. Wilhelm
Bureau of Mines

G. M. Knebel
Jersey Standard

J. Cable
Cable & Stine

C. R. Fettke
Carnegie Tech.

Division of Production

Tuesday, November 9, 1943

8:00 P.M.

Drilling and Production Practice:
(Sponsored by the Central Committee on Drilling and Production Practice)
Presiding: F. E. Heath, Sun Oil Co., Dallas, Texas, and M. H. Parks, Humble Oil and Refining Co., Houston, Texas.

Standardization of Electrical-Log Headings.
W. L. Jarvis, The Texas Co., Los Angeles, Calif.

Counterbalancing of Oil-Well Pumping Machines.
E. N. Kemler, Purdue University, Lafayette, Ind.

Wednesday, November 10, 1943

9:00 A.M.

Production and Pipe-Line Transportation Under War Conditions:
Presiding: T. E. Swigart, Shell Pipe Line Corp., Houston, Texas.

Building the "Big Inch" Pipe Lines.
Burt E. Hull, War Emergency Pipelines, Inc., Cincinnati, Ohio.

Manpower—The Industry's No. 1 Problem.
John M. Lovejoy, Chairman, PIWC Committee on Manpower; Seaboard Oil Co. of Delaware, New York, N. Y.

Drilling Efficiency Under War Conditions.
Arch H. Rowan, American Association of Drilling Contractors, Fort Worth, Texas.

Thursday, November 11, 1943

9:00 A.M.

Drilling and Production Practice:
(Sponsored by the Central Committee on Drilling and Production Practice)
Presiding: T. H. Acres, Richfield Oil Corp., Los Angeles, Calif., and S. E. Buckley, Humble Oil and Refining Co., Houston, Texas.

The Foaming Tendency and Stability of Crude Petroleum.
W. H. Somerton, University of California, Berkeley, Calif.

A New Application of Water Injection for Maintaining Reservoir Pressure and Increasing Natural Water Drive.
W. L. Horner and D. R. Snow, Barnsdall Oil Co., Tulsa, Okla.

Permeability as Related to Productivity Index.
Norris Johnston, General Petroleum Corp. of California, Los Angeles, Calif., and J. E. Sherborne, Union Oil Co. of California, Santa Fe Springs, Calif.

Report of Division's Nominating Committee.
George S. Bays, Stanolind Oil and Gas Co., Tulsa, Okla., Chairman.

Election of Twenty Members of the General Committee of the Division of Production.

GENERAL SESSIONS

Grand Ball Room

Wednesday, November 10, 1943

2:00 P.M.

Report of Board of Councillors and Election of Directors.

President's Address:
William R. Boyd, Jr., President, American Petroleum Institute; Chairman, Petroleum Industry War Council.

Address:
Colonel Bradley Dewey, Rubber Director, War Production Board, Washington, D. C.

Address:
Warren H. Atherton, National Commander, American Legion, Indianapolis, Ind.

Address:
Ralph K. Davies, Deputy Petroleum Administrator for War, Washington, D. C.

8:00 P.M.

General Session—Motion Pictures:
"Belvoir" Film—Oil Executives Go to War.
"Oil for War"—Film Covering Construction of the "Big Inch" Pipe Line.
"At the Front"—The Army Signal Corps Battle Picture of Tunisian Campaign.
(These will be shown through the courtesy of The Barrett Division, Allied Chemical and Dye Corp., New York, N. Y.)

Thursday, November 11, 1943

2:00 P.M.

Address:
Hon. Harold L. Ickes, Secretary of the Interior; Petroleum Administrator for War, Washington, D. C.

Address:
Charles E. Wilson, Executive Vice Chairman, War Production Board, Washington, D. C.

Address:
Hon. Artemus L. Gates, Assistant Secretary of the Navy for Air, Washington, D. C.

Chicago Area Fuel Oil Crews Rated 'Locally Needed'

NPN News Bureau

CHICAGO—War Manpower Commission has temporarily designated the metropolitan Chicago area, including Cook, DuPage and Will Counties as "locally needed" for the delivery of fuel oil, B. L. Majewski, chairman of District 2 marketing committee has announced.

New ruling is effective for the period of Oct. 27, 1943 to Jan. 27, 1944, but only to those fuel oil distributors who certify by letter to ODT loca'ly and to E. L. Hughes, PAW District 2 marketing director, that they are making the most effective use of their delivery and storage equipment, and efficient use of manpower, Majewski said.

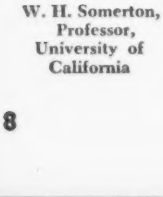
Oil Distribution 'Essential', Is California Ruling

NPN News Bureau

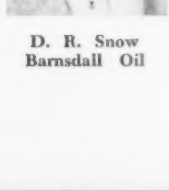
LOS ANGELES — California State Manpower Director H. R. Harnish has declared the warehousing and wholesale distribution of petroleum products to retail outlets in Southern California an essential activity.

The declaration is effective as of Oct. 10, 1943 and includes the following counties: Santa Barbara, Ventura, Inyo, Mono, Kern, Los Angeles, Orange, San Bernardino, Riverside, San Diego, and Imperial.

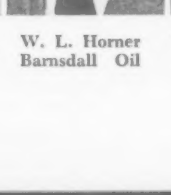
In accordance with the declaration of essentiality, the employees in the warehousing and wholesale distribution of petroleum products are instructed not to change their employment except in accordance with the provisions of the Southern California Employment Stabilization Plan.



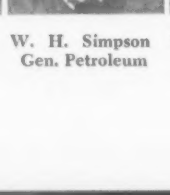
W. H. Somerton,
Professor,
University of
California



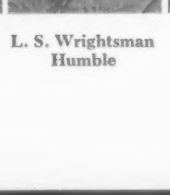
D. R. Snow
Barnsdall Oil



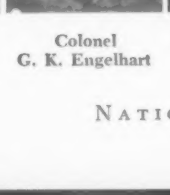
W. L. Horner
Barnsdall Oil



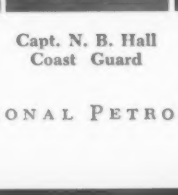
W. H. Simpson
Gen. Petroleum



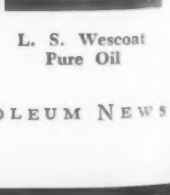
L. S. Wrightsman
Humble



Colonel
G. K. Engelhart

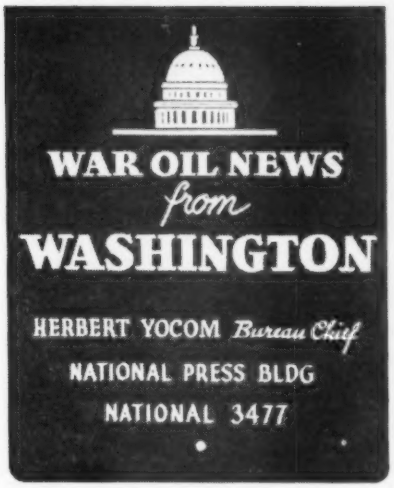


Capt. N. B. Hall
Coast Guard



L. S. Wescoat
Pure Oil

Brewster Demands Greater Use of British Oil; Warns U. S. May Become 'Have Not' Nation



NPN Staff Special

WASHINGTON — In blunt, plain-spoken language, a member of the potent Truman committee let it be known this week that Congress will not be deterred in its determination to compel a greater use of British reserves in meeting war oil requirements.

Waxing caustic at what he termed New Deal "sensitivity" to charges that the British are contributing too small a share of fightin' oil, Senator Brewster, of Maine, warned that unless this situation is corrected, "before another generation comes on the stage America will be a mendicant for petroleum at the council tables of the world."

Thus, added emphasis attaches to the current inquiry of the Truman committee into the facts of world supply and the activities of Petroleum Reserves Corp. in the field of foreign oil.

That inquiry, said Senator Brewster, will "continue to be pressed" to the end that "reports on the situation will in due course be forthcoming." And what the Truman committee has to report or say or recommend on any subject, whether it be tanks, or ships, OR OIL, will be hearkened to, and heeded, and acted upon by official Washington, if the record of past performance is any criterion.

Names Middle East Mission

Meantime, these other developments highlighted the week from the standpoint of world oil:

1. PRC President Ickes announced the personnel of the Corporation's mission to the Middle East, which will be heading overseas any day now.

2. Senator Byrd, of Virginia, economy-minded watchdog over Federal expenditures, asked Ickes for a statement as to the legal authority under which PRC was set up and for a report on its spending plans.

3. PAW reorganized its foreign division into 3 divisions with an over-all operating committee to coordinate their functions. The following were named division heads: William D. Crampton, formerly associate director of foreign division, director of foreign supply and distribution; William B. Heroy, formerly PAW's director of reserves, director of foreign production; Stribling Snodgrass, former foreign division director, director of foreign refining.

Head of PRC's expedition to the Middle East is youngish Abe Fortas, Undersecretary of the Interior and PRC secretary, who was recently inducted into the Navy, but has been granted leave. Other members include W. E. Wrather, director of the U. S. Geological Survey. E. DeGolyer, PRC consultant and former assistant PAW Deputy, and John H. Murrell, petroleum engineer assistant to DeGolyer.

"Upon its return (from overseas)," said Mr. Ickes, "the mission will report to the president of the corporation and the directors who include the Secretaries of State, War, Navy, Interior and the Administrator of the Foreign Economic Administration."

"The primary objective of the mission," he added, "involves first-hand surveys and observations of foreign petroleum facilities and arrangements available in that area to supply the fighting forces abroad, and the members will also seek a closer integration of foreign production and distribution of petroleum products into our domestic supply pattern."

Senator Brewster's outspoken comment on the issue of world supply and demand was contained in his report to the Truman committee on what he saw and learned on his recent visit to the overseas battlefronts, in company with other senators.

What concerns him, he said, is the fact that only 8 per cent of the oil consumption of the United Nations is at present coming from British sources, while nearly 80 per cent is coming from U. S. reserves. Yet, he added, when he and the other globe-girdling senators recommended that "a great deal more oil should be provided from the deposits of the Middle East" the only result seems to have been the development of "considerable sensitivity" in administration quarters and a wave of "both explanation and excoriation."

Other Nations More Prudent

Other points made by the Senator:

"Current comment on the prospect that the U. S. oil reserves are only sufficient to supply us for 12 to 15 years at the present rate of consumption do not seem to occasion particular concern."

"Other countries are far more prudent in husbanding their petroleum reserves. While Britain has oil reserves at least equal to the U. S., the British reserves at the present rate of consumption will last 100 years."

". . . the largest supply from any country outside the U. S. comes from a country bordering on the Caribbean where 80 per cent of the reserves are owned by an American corporation and a 30 per cent increase in production is contemplated this coming year, while practically no increase in production is contemplated for the great British reserves in the Persian Gulf. . . .

"Equitable distribution of available supplies to meet the military needs of the United Nations is all that is desired. Is this treason?"

Premium 'Gas' Cut to 76 Octane, Regular 72

NPN News Bureau

WASHINGTON — PAW, Nov. 2, placed nationwide ceiling of 76 on octane rating of premium gasoline for civilians and ordered reduction in volatility of both premium and housebrand motor fuels.

Instructions telegraphed to all U.S. refiners also pegged rating of housebrand at maximum of 72, which is about present average. The new specifications make allowances for temperature variations in different sections of the country. Effective date for the revised specifications is Nov. 8.

Action was taken to conserve tetraethyl lead and to release the more volatile gasoline fractions for manufacture into aviation fuels and 80-octane all purpose military gasoline. Effect of cut in premium from present octane ratings between 78 and 80 to 76 will be to make saving of one-third in civilian consumption of TEL.

No Other Choice, Davies Says

Deputy PAW Davies stated that while the 2-4 point drop in octane number of premium gasoline will be noticed by some motorists, PAW unfortunately had "no choice of action—we cannot fail to meet the military requirements."

He added that reduction in volatility is necessary "because refiners were having considerable difficulty in meeting volatility requirements both for military and civilian uses." The cut is so slight, however, he said, "that the motorist will notice it only during the colder periods when it may take a bit more time to get the motor warmed up."

Average Numbers Listed

PAW announcement of the action gave the following as average octane number of premium grade sold in various cities and areas during the winter of 1942-3, based on Bureau of Mines survey:

Boston, 79.8; New York, 79.1; Pittsburgh, 80; Washington, D.C., 79.7; Cleveland, 79.5; Detroit, 79 3; Atlanta, 80.2; Memphis, 80.2; Chicago, 79.1; New Orleans, 80; St. Louis, 79.0; Minneapolis, 78.8; Omaha, 78.9; Tulsa, 78.9; State of Texas, 78.9; Middle Rocky Mountains, 79.3; North Rocky Mountains, 79.2; Seattle, 80.5; Los Angeles, 81.1; and San Francisco, 80.4.

Gasoline from Coal Bills Reported To House, Senate

NPN News Bureau

WASHINGTON — Gasoline made from coal will fuel an airplane in which Sen. O'Mahoney, Wy., and Rep. Randolph, W. Va., fathers of legislation pending in both houses of Congress to foster further experimentation on gasoline-from-coal processes, plan to ride from Morgantown, W. Va., to the capital Friday or Saturday.

The fuel "cached" at Morgantown, produced at the Bureau of Mines experimental plant at Pittsburgh, would be an advance taste of a much larger volume made available to supplement normal supplies produced from petroleum in the aviation picture of the future, under the program envisioned by the Randolph and O'Mahoney bills.

Way was prepared for action on these bills in both houses when Rep. Randolph on Nov. 1 submitted a favorable report from the House Committee on Mines and Mining on his bill, H.R. 3209. Sen. O'Mahoney's substantially identical bill, S. 1243, was favorably reported from Senate Public Lands Committee on Oct. 6.

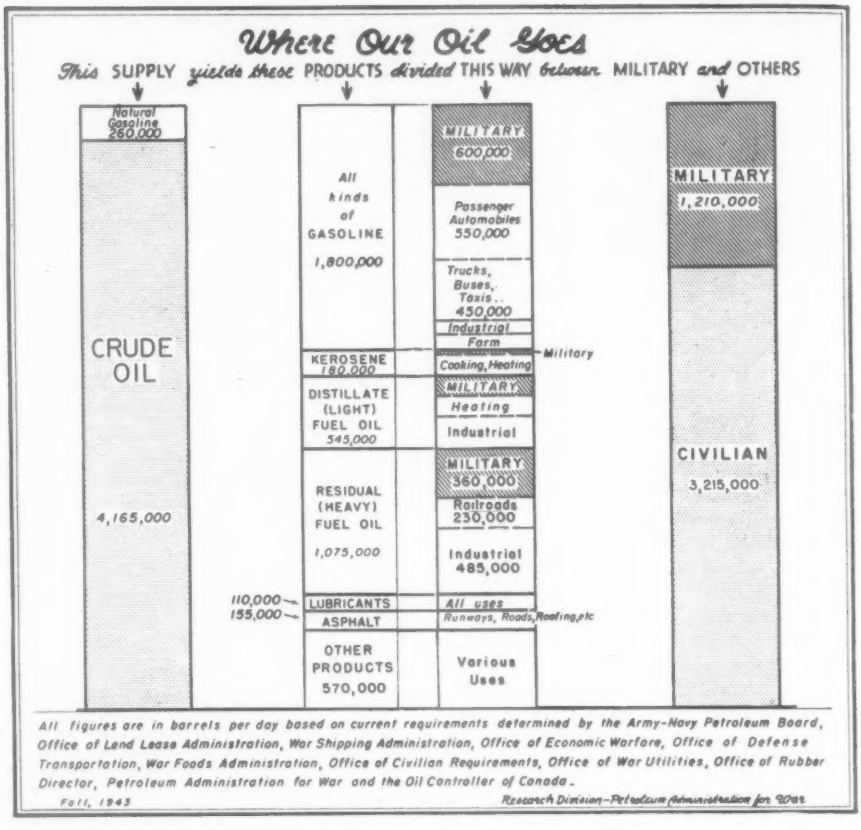
Both bills would authorize the Secretary of the Interior, acting through the Bureau of Mines, to "construct, maintain and operate one or more demonstration plants to produce synthetic liquid fuels from coal and other substances . . ." The only substantial difference between the two is that the Randolph bill was amended in committee to limit total expenditures to effectuate these ends to $30,000,000. (At an estimated cost of $8-10,000,000 apiece, Rep. Randolph explains, this would permit construction of three plants.)

A provision was inserted by amendment in both bills to limit size of plants so that "the combined product of all the plants constructed in accordance with this act will not constitute a commercially significant amount of the total national commercial sale and distribution of petroleum and petroleum products." This provision was added when committee hearings revealed some public fear that the authority might be used to put government in competition with private industry.

Coupon Pickup Order Eased For Deliveries to Farms

NPN News Bureau

WASHINGTON—A farmer who is in his field or elsewhere on his farm is "absent" within the meaning of Section 8153 (c) (1) (i), Ration Order 5C, R. R. Koerner, Chief Counsel of the Gasoline Section of OPA, has ruled in a message recently teletyped to all OPA head attorneys. Briefly, this section permits the consumer to forward coupons or ration check to his supplier within 7 days after receiving a bulk delivery of gasoline.


Where Our Oil Goes
This SUPPLY yields these PRODUCTS divided THIS WAY between MILITARY and OTHERS
Natural Gasoline 260,000
CRUDE OIL
4,165,000
All kinds of GASOLINE 1,800,000
KEROSENE 180,000
DISTILLATE (LIGHT) FUEL OIL 545,000
RESIDUAL (HEAVY) FUEL OIL 1,075,000
110,000
155,000
LUBRICANTS
ASPHALT
OTHER PRODUCTS 570,000
MILITARY 600,000
Passenger Automobiles 550,000
Trucks, Buses, Taxis.. 450,000
Industrial
Farm
Military
Cooking, Heating
MILITARY
Heating
Industrial
MILITARY 360,000
Railroads 230,000
Industrial 485,000
All uses
Runways, Roads, Roofing, etc
Various Uses
MILITARY 1,210,000
CIVILIAN 3,215,000
All figures are in barrels per day based on current requirements determined by the Army-Navy Petroleum Board, Office of Land Lease Administration, War Shipping Administration, Office of Economic Warfare, Office of Defense Transportation, War Foods Administration, Office of Civilian Requirements, Office of War Utilities, Office of Rubber Director, Petroleum Administration for War and the Oil Controller of Canada.
Fall, 1943
Research Division—Petroleum Administration for War

Ickes Maps Nation's No. 1 Petroleum Needs— Millions for War and Less for Civilians

NPN Staff Special

WASHINGTON — Military requirements of gasoline, fuel oils, lubricants and other petroleum products now total 1,210,000 b/d, PAW Ickes announced this week in his most comprehensive statement yet on the extent of war demand for American oil.

Ickes backed up his announcement with charts, showing the division of total petroleum supplies between military and civilian consumers and illustrating how the need for making more war products has reduced the quantity of civilian motor gasoline that can be made from a barrel of crude from 18 gallons before Pearl Harbor to only 12 gallons today.

"The facts which we can now make public show the terrific drain that war is imposing on our dwindling petroleum reserves," said the PAW head.

"They give striking emphasis to the basic petroleum problem with which we are all confronted, whether we be oil producers, refiners or transporters, or civilians wishing that we had more gasoline.

"More than 30 per cent of all our gasoline must now go straight to power the expanding bombing attacks, expanding fighter missions, expanding air transport operations all over the world and to fuel the thousands of tanks, jeeps, trucks, and motorized artillery on literally hundreds of separate fighting fronts —and the need will increase until this war is won.

"More than 25 per cent of all our light fuel oil must go straight to military power plants, machinery and fighting equipment.

"Approximately 30 per cent of the heavy fuel oil we produce goes straight into the bunkers of our expanding Navy, merchant marine, and for dozens of other direct military power uses.

"About one-quarter of the kerosine available today must likewise go straight to war—to warm the quarters of thousands of soldiers in Arctic outposts, for cooking and lighting purposes along the global service lines of the fighting quartermasters.

"These are the No. 1, the absolute must petroleum needs, that can be met fully only through the continued conservation of petroleum products by every citizen."

Bans Half-Million Gallons Of Harmful Anti-Freeze

NPN News Bureau

WASHINGTON—All sales of an estimated 500,000 gal. inventory of 2 destructive types of anti-freeze solution were banned by WPB Nov. 1. Two types are listed as those compounded with inorganic salts, including calcium, magnesium or sodium chloride, and petroleum distillates. The types considered safe for use are ethylene-glycol or alcohol and in-

ventories are ample to supply all essential needs, WPB says.

Action was taken in an amendment to Order L-258, which was issued last January, prohibiting further manufacture of destructive types of solutions. WPB pointed out that National Bureau of Standards identified 22 of these products as coming within the definition of anti-freeze solutions prohibited by the stop-production order. These products are among those prohibited for sale by new order. WPB lists trade names of these as follows: All-Winter, Chem-A-Cool, Frozone, Permazone, Wonder-Solv, Lo-Zone, Alcotex, Ever-Flo, Bird Antarctic, Flexo, Gold-Seal, Security, Ant-Arctic, Neva-Freeze, Anti-Frost, Bond (top line) Fre-Tex, No-Freeze, 60-Below, Lo-Temp, Never Freeze and No-Boil.

Directive 70 Assailed On House Floor

NPN News Bureau

WASHINGTON — PAW's Directive 70 on foreign operations bobbed up on Capitol Hill last week in a speech on the House floor Oct. 28 by Rep. Voorhis, Calif., in which he expressed concern lest the operation of the Directive, as well as others issued by PAW, were leading to "a more extreme monopoly situation in our oil industry than any we have ever known before."

On Nov. 1, Mr. Voorhis arose again in the House and placed in the record a reply from PAW Chief Counsel Marshall in which the latter said, in part:

"It is extremely questionable whether the directive contains any provisions which in any way violate the antitrust laws of the U. S."

Petroleum Directive 70, wrote Marshall, is "purely a war measure" and it will be revoked as soon as PAW or WPB find it necessary for the prosecution of the war.

Denies it Helps Majors

"I do not believe," Mr. Marshall said, "that there will be any advantages to the major oil companies in the post-war period stemming from any action directed under Petroleum Directive 70."

WPB's certificate that Directive 70 was necessary to the prosecution of the war goes much further than merely suspending the antitrust laws with regard to the decisions, program and actions of the foreign operations committee under the directive, said Mr. Voorhis.

The certificate, he added, "is all that was needed to make complete suspension of the antitrust laws an accomplished fact. Such suspension has by that certificate been approved in blanket fashion by the chairman of the War Production Board and henceforth anything whatsoever which the foreign operations committee may decide or wish to do now or in the future is exempt from any antitrust law on the statute books.

"I think the House and the Nation should be apprised of the exact situation."

Army Switches Oil Command

NPN Staff Special

WASHINGTON — The Army has shaken up the command of its Fuels and Lubricants Division. After less than 6 months as head of the division charged with responsibility for all petroleum supplies excepting aviation gasoline, Brig. Gen. William E. R. Covell has been quietly eased from his post and replaced by Brig. Gen. Howard Peckham of the regular army.

The change was made several weeks ago, but for some reason the Army chose not to make it public.

Switch in chiefs was ordered by Lieut. Gen. Brehon Somervell, commander of the Army Service Forces, who had directed consolidation of all ASF petroleum under Covell, effective last June 1.

Lieut. Col. Jay L. Taylor, formerly vice president and general manager of Halliburton Oilwell Cementing Co., retains his post as second in command to Gen. Peckham.

Revenue Bureau Eases Salesmen's Pay Rule

NPN News Bureau

WASHINGTON — Internal Revenue Bureau Nov. 1 extended to the end of the year exemption of salesmen's commissions from effect of salary stabilization regulations, if rate of commission or amount of other compensation has not been increased since Oct. 2, 1942.

Statement issued by Internal Revenue Commissioner Robert E. Hannegan approves payment of any commissions earned on individual sales during calendar year 1943, and includes payments which, in normal course of business, may be made subsequent to Dec. 31, 1943, on account of commissions earned during 1943. Approval does not apply to overriding commissions, such as commissions to an employe based on sales of other employes.

Salesmen's commissions were brought within scope of salary stabilization regulations when latter were revised Sept. 4. Employers were forbidden to pay any commission which would bring total amount paid to employe to more than the same employe received during last accounting year ended before Oct. 3, 1942.

This meant that some employes, whose earnings before Sept. 4 had already reached or passed this limit, were barred from receiving further compensation for remainder of the year. Recognizing hardships resulting from this situation, IRB on Oct. 7 extended permission to employers to continue commission payments through September and October at the regular rate in cases in which neither rate of commission nor amount of additional compensation (such as base pay) had been increased since Oct. 2, 1942. Latest ruling extends this permission until the end of 1943.

OPA Relaxes Retailers' Price Restrictions

NPN News Bureau

WASHINGTON—Price restrictions on retailers of petroleum products were eased in 3 minor respects this week when OPA announced 3 amendments to MPR 137, all to be effective Nov. 9.

Amendment 38 authorizes regional OPA administrators to adjust ceiling prices under state fair trade laws. Adjustments will be granted any seller who shows (1) that his maximum price for a commodity under this regulation is less than his minimum price during March, 1942, pursuant to a contract entered into in accordance with the fair trade act of any state; (2) that the commodity was generally sold at retail during March, 1942, at such minimum price in his locality; and (3) that he has been permanently enjoined by a court from selling the commodity at less than such minimum price.

Under Amendment 39, retailers who have chosen to set their maximum prices by adding 3 cents a gal. to their delivered costs may now add the 3 cents a gal. to their suppliers' maximum tank wagon prices instead of his actual selling price in cases where he has not taken advantage of his maximum price.

Amendment 40 permits a new operator of a service station or other retail petroleum establishment to change to a new brand of petroleum product and charge for it the maximum price of his most closely competitive seller, without being limited to the maximum price of his predecessor, if operations at the site have been suspended for at least 60 days before he took over.

Revokes Preference Ratings

NPN News Bureau

WASHINGTON — WPB announced Oct. 28 revocation of preference ratings previously granted to 6 oil companies for construction of facilities at request of applicants as follows:

Shell Oil Co., Washington, D. C., for construction of 4 crude oil storage tanks in East, South and West Texas, Louisiana, and New Mexico; total estimated cost, $3,634.

The California Co., New Orleans, La., for construction of crude oil storage and barge loading facilities at Delta Farms oil field, LaFourche Parish, La.; total estimated cost, $25,459.

Plantation Pipe Line Co., Atlanta, for increased pumping, pipeline and storage facilities at Baton Rouge; total estimated cost $142,000.

Leonard Pipe Line Co., Mt. Pleasant, Mich., for erection of 2 steel oil tanks and fittings, 1 in Fork Township, Mich., and other in Aetna Township, Mich.; total estimated cost, $7,636.

Hamman Oil and Refining Co., Houston, for construction of new facilities to increase crude oil distillation capacity at its Bay City, Tex., refinery; total cost of project, $15,212.

PIPELINES—*Views of the Industry's Problems*

Washington— *Vinson's Voice But Pedrick's Hand?* —By Herbert Yocom

WASHINGTON—Who actually wrote Judge Vinson's crude price decision?

Was it the Judge himself? Best guess as to that is No. Reason: He just doesn't have the time to give to the writing of a decision which runs to 19 single-spaced mimeographed pages.

Mr. Yocom

Was it Sumner Pike, chief of OPA's fuels price division who had more than a little to do with the two OPA rejections of PAW Ickes' recommendation for a price increase? The answer to that is probably No, although all of the alternative measures for increasing production suggested by Judge Vinson are obviously OPA-inspired.

If neither Vinson nor Pike, then who did write it?

Strictly out of the hat, this corner stands ready to bet a plugged nickel that inquiry by the proper authority would develop that the individual who wrapped up the no-increase package for the Economic Stabilizer answers to the name of Willard H. Pedrick.

And who is Pedrick? Well, he's the young Texan who sat at the elbow of Judge Vinson at that famous last meeting of the master minds of PAW and OPA at which the judge listened, as it were, to the closing arguments for and against a price rise. No other member of the stabilizer's staff was present —just the Judge and Pedrick.

If that doesn't suggest something then certainly this does: In all of Vinson's preliminary quests for information from PAW and OPA, the man both agencies had to deal with was—you guessed it—not Vinson, but PEDRICK.

And, whose name do you think appeared atop the press release issued by Judge Vinson through the office of War Information? Right again—PEDRICK! Any newsman who had any question about what was in the decision had only to dial REpublic 7500, tell operator he wanted Extension 71479, and when he got it ask for Mr. Pedrick.—He'd have the answer.

What is Pedrick's background? Inquiry develops that he's a teacher of the law, on loan to Judge Vinson from the University of Texas Law School after a brief tour of duty in the Tax Division of the Justice Department. Before going to Texas, he is said to have been a member of the law faculty of the University of Cincinnati.

Any practical oil experience? Don't know, but probably not.

* * *

Just Window Dressing

The feeling in Washington oil circles now is that Judge Vinson's get-together with PAW and OPA on Oct. 25, ostensibly for the purpose of finally making up his mind, was just so much window dressing.

Belief is that the verdict was already in; that the writing of it probably had been largely completed. If not, then Pedrick—if we're right in picking him as the Judge's ghost writer—must have burned the midnight oil to get the written decision, with all its footnotes, citations and what not, down in black and white between late Monday afternoon and Thursday evening, which was when the finished product went to OWI for mimeographing.

* * *

Doubt Africa 'Gas' Charge

If Senator Brewster of Maine and the other Senators recently returned from the battlefronts think that civilians in North Africa are getting too much gasoline, then the man they had better see about it is Gen. Ike Eisenhower.

As the commanding general in that theater of operations, Gen. Eisenhower does the allocating of gasoline in North Africa. He and he alone has authority to say how much shall go to whom, including the civilian population.

Army officials here say privately they doubt the General is allowing civilians more than barely enough to meet their minimum essential requirements; "guess" that if Brewster saw much driving in North Africa, cars actually were being used for military purposes as the military forces have commandeered many automobiles in that region.

Atlantic Coast— *New Dealer Limitation Plan Hits Snag* —By Henry Ozanne

NEW YORK—District One's long-awaited and controversial dealer limitation program tentatively is scheduled to go before the Marketing Committee Nov. 4. The Gasoline Dealers Subcommittee spent 3 days last week mulling over the new order and emerged with a rough draft which was sent on to the District Committee for final wording. The dealers themselves are supposed to have worked out the content, the District Committee is to limit itself to the language of the instrument. However, it is understood that several snags have been encountered and the Marketing Committee, once it gets hold of the draft, may insist on wide changes.

Mr. Ozanne

The issue of "adjustments" is still the bone of contention. The dealers generally demand the elimination of an adjustment clause such as characterized the old L-70. That device which permitted great flexibility in "normal gallonage" on the basis of a station's expected volume of business, proved to be a politically competitive mechanism, the dealers say.

The chief argument against the adjustment provision is that it plays the dealers into the hands of the majors. As one dealer expressed it here: "For whatever adjustments are needed, we want those adjustments made by PAW, not by the majors."

It is learned that a new base period was chosen in the 3-day dealers' subcommittee session last week. Originally the dealers had fixed on a base period comprising the last 6 months of 1942, but it was discovered that no zone records were available prior to last September, so 2 new base periods were suggested: September, 1942, to February, 1943; or October, 1942, to March, 1943.

Some headway appears to have been made toward harmonizing the long conflicting views between PAW and OPA on the problem. OPA is still opposed to the whole quota theory which is at the base of dealer limitations, but it is understood OPA has agreed to sit in with the dealers at some meeting in the near future to see if some profitable exchange of ideas can be made.

OPA's argument has been that any new limitation plan following the lines of the former L-70 would suffer the weaknesses of that order—that it would deal with the supply situation as a static rather than a constantly changing problem and to introduce any workable flexibility at all, the new order would require too many exceptions.

The dealers reply that OPA's own records emphasize the need for some sort of limitation program immediately. The

black market problem is still bad and can't be effectively combatted until limitation is under way, the Marketing Committee has been told by John A. Dressler, head of the Eastern States Gasoline Dealers Assn. and of the New Jersey association.

"Ninety percent of the dealers are honest", Mr. Dressler said, "and this plan of ours will let them stay honest."

The dealers have painted a picture of hundreds of their members becoming unintentionally involved in black market practices through the forced purchase of coupons to keep up their inventories. One association official said: "OPA could close 75% of the stations now if it wished to do so."

Clean Up Drive Traps Many

The widespread black market and its threat to dealers appear confirmed in recent OPA figures. About 275 stations have been suspended in the New York area during the last 2-months "clean up" drive by OPA, and in Newark, N. J., 100 are expected to be trapped in the current OPA campaign. In Newark 62 previously accused operators have already pleaded guilty and are awaiting sentence.

One dealer said: "The black market is licked when it becomes impossible to take coupons into a station for sale to the operator. The limitation plan would force the racketeers to turn direct to the motorists, and this would break the back of the black market."

In Rhode Island, State OPA Director Christopher Del Sesto recently called a meeting of gasoline and oil dealers to publicize black market practices and urge all dealers who have become in any way involved to "'fess up immediately—get yourselves clear right now." Six hundred dealers assembled to hear Director Del Sesto warn that agents are going to crack down hard.

"On Nov. 1", he said, "we are making every dealer turning in counterfeit stamps liable; every coupon will be charged against the ration account of the dealer and the dealer who continues to take them in will find himself out of business."

Mid-West Roundup— *Credit Cards Stir Heated Debate* —By Earl Lamm

CHICAGO—What is the future of service station credit cards? It's a highly controversial subject, although for the time being the cards are a dead issue. Their general use was banned for the duration by PAW Directive 62, effective Feb. 1, 1943.

Mr. Lamm

However, prospects are that the discussion of their eventual revival will get warmer as time passes, for oil company credit managers who are members of the petroleum division, National Assn. of Credit Men, have appointed a 3-man committee to make a re-survey of oil companies and dealers on whether or not the cards should be revived in the post war period.

The previous survey was reported in NPN, Nov. 1, 1939, p. 9, and showed the total cost of handling a credit card account, including bad debt loss, averaged 85/100 of 1 cent per gallon of gasoline charged. The survey covered 26 oil companies representing all sections of the country, based on 1938 and 1939 data. Average loss on credit card accounts was 79/100 of 1 per cent, the survey showed, and the average monthly purchase, $11.81.

When use of the cards was banned last February, many oil companies were glad to get rid of them and still hope they will not come back, but there are others who feel differently. The objectional viewpoint was covered at the meeting of credit managers, and the new survey was ordered in discharging what they feel as their responsibility to management in bringing to attention the added cost of distribution.

But having a look at the other side of the question since the St. Louis meeting, retail marketing departments bring out their favorable comment, which applies to the prewar and postwar periods, and not to the present sub-normal rationing era, as it is not anticipated that any attempt will be made to bring the cards back into use until the war is over.

Last experience was that credit cards represented only 2% to 3% of a company's total sales, or 8% or 10% of the total business done at service stations, the sales departments argue. Since the volume is not large, credit losses cannot be great.

Credit cards represent the last ounce of "oomph" that pushes sales up. Other sales department comment:

It's not always true that vacationists will splurge for a long two weeks trip, then cut down the following month. Also, motorists who drive to work frequently tell the parking lot attendant to "Fill'er up with gas, and I'll get her tonight."

To any active salesman, a laconic remark like that is an open invitation to solicit a wash job, a grease job, and a change of crank case and transmission oil. Maybe a motor tuneup, resulting in a total bill of several times the price of the gasoline, especially if the customer can use a credit card and will not have to put out cash until he gets his salary check at the end of the month.

Answering the charge that credit cards represent wild or uncontrollable credit, it was agreed that maybe so—but 97% to 98% of the people are honest, and any losses are awfully small. Possibly credit cards do give major companies with national distribution an advantage over smaller independents, but it was contended that there is a compensating balance—independents should be able to get closer to local customers, which is said to be a big factor in obtaining home business.

If and when credit cards are brought back, some companies have tentative plans for restricting their use by fixing a minimum monthly purchase amount, say $8 or $10 per customer, which would have the effect of limiting many customers to the use of only one company's card.

It is realized that anti-trust regulations preclude any general agreement, but "regardless of that, our cards are never again going to be passed out promiscuously," was the sentiment of two companies.

When cards were eliminated last February, it was more or less expected that there would be a buying shift from national brands to trackside stations, because of the 1c or 2c saving in price, but apparently that hasn't taken place.

"We can not tell that it has affected our business," said one spokesman who had predicted the change. "But had it occurred, it would have cost us many times more to get the business back than it would have cost to continue with credit cards. I still contend credit cards are good merchandising."

Perhaps the reason there has been no such shift of buying to trackside operators is that motorists count only ration coupons in terms of mileage, with cash cost a secondary consideration, which is the case with many housewives ("A" users) in search of scarce food items like meat.

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Recognizing the condition cited in this column last week, that many oil men are not active on industry committees and are being "forgotten", PAW Director Vandeveer is assembling a "flying squadron" of half dozen men, who will carry PAW and the many wartime industry problems direct to the oil men. This idea is an extension of PAW's "grass roots" conferences, as he can not hope personally to visit all points over the 15 states of District 2. Time does not permit.

Digest of Week's War-Oil Orders

(Issued Oct. 23-30, inclusive)

Petroleum Administration for War

FATTY OILS—PAO 10, restricting use of fatty oils in manufacture of lubricating greases, revoked. Issued 10-25, effective 10-30.

Office of Price Administration

PRICE RAISE—RPS 88, Am. 132—Ceiling for liquefied petroleum gas for cooking and heating in Alcorn County, Mississippi set at 12c gal., replacing former 10c price of March, 1942, then profitable because of sales of systems and appliances no longer available. Issued 10-26, effective 11-1.

NATURAL GAS & CRUDE CEILINGS—MPR 436, Am. 4—Individual adjustment of prices permitted under 4436, if they are capable of remedying local shortages in commodities or services essential to the war effort, in line with similar adjustment permitted under GMPR and numerous commodity price regulations. Applications to be filed as prescribed by Revised Proc. Reg. 1. Am. 1 (Pickens Field increase) made effective as of 5-26-43. All crude transported by War Emergency Pipelines exempt from price control. Issued 10-27, effective 11-1.

BATTERY PRICES—MPR 136, Am. 101—Machinery service defined to include any service rendered in connection with manufacture of automotive parts. Among numerous additions to Electrical Equipment list of Appendix A (Oct. 1, 1941 date applicable) are storage batteries, including automotive, synchronous condensers and converters, motors, industrial power rectifiers. Issued 10-26, effective 11-1.

FURFURAL—GMPR—Revised SR 14, Am. 43—Specific tank car price for furfural sold in U.S. by producers set at 9.5c lb., f.o.b. plant. March 1942 differentials, discounts, etc. apply. Issued 10-26, effective 11-1.

CORRECTION—RO 5C, Am. 77—Deadline for distributors' redemption of former-value coupons corrected to read "October 11" instead of "October 6". Issued 10-21.

REVIEW AND CANCELLATION OF RATIONS—Redemption of Out-of-Date Coupons—RO 5C, Am. 81—District Directors, as well as Regional Administrators, or their designated representatives may review any board's granting of rations to any consumer and any dealer's or distributor's right to deposit certain coupons. Certificate or ration holder after due notice, may appear in own defense and produce evidence supporting his claim. Failure to establish right to ration or certificate requires surrender of coupons by holder or dealer in manner prescribed by OPA repersentative. Dealers and intermediate distributors unable to redeem before expiration coupons acquired since 9-22-43 may file, with expired coupons, Form OPA R-541, in triplicate, stating reason for delay. Board may allow claim and issue valid inventory coupons therefor; or may disallow claim, retaining invalid coupons and returning those still valid, though for less value than that at which received by applicant. One copy of application and disposition thereof filed with District Chief Enforcement Attorney. Licensed distributor wishing to redeem such out-of-date coupons files same application; two copies endorsed by Board and returned to distributor, to be included with his next monthly state motor fuel tax report, attached to reconciliation statement, with explanation. Washington OPA may then credit licensed distributor with value of coupons, and instruct board to destroy coupons so surrendered. Issued 10-29, effective 11-3.

STOVES—RO 9A, Supp. 1, Am. 2—Distributors in "emergency oil shortage area" may apply to board for increase in permitted inventory of coal and wood heating stoves up to 10% of former oil-heating-stove sales if sales shown on registration statement show at least that proportion then obtained. Issued 10-26, effective 10-30.

RO 11, Am. 84—Restriction against issuance of fuel oil rations for generation of electric power removed, upon recommendation of WPB Office of War Utilities. Issued 10-28, effective 11-2.

USED LUBRICATING OIL—RO 11, Am. 85—Used lubricating oil subject to rationing restrictions to prevent reclaimed oil's use by those not entitled to fuel oil rations. Period during which dealers and suppliers required to retain records increased to 2 years. All records must be on hand at place of business. Issued and effective 10-21.

War Production Board

NATURAL GAS—L-31 and L-31-a—General Limitation Order L-31 and Supplementary Limitation Order L-31-a revoked, and superseded by Utilities Order U-7. General Directive 2 under L-31 (issued 8-26-43) reissued as WPB General Directive 2 under U-7. Issued 10-25.

Utilities Order U-7—Natural gas redefined to include fuel gas derivatives of petroleum, etc., but excluding liquefied petroleum gas in liquid phase. Non-utility suppliers, as well as utility suppliers, prohibited from abandoning gas-manufacturing facilities except on specific WPB authorization. WPB may issue specific direction to both classes of suppliers to curtail gas deliveries to certain classes of consumers, to make available deliveries to suppliers serving consumers, where shortage threatens war effort, etc. Any supplier may request such help. All services and interconnections must be retained in shortage areas as of 10-1-43. Rules for operations during gas shortages permit cutting off of service to commercial consumers except to extent necessary to prevent permanent damage to production and service facilities. Deliveries to domestic consumers subject to WPB direction. Filing of classification of industrial and commercial consumers on Form WPB-619 required by 11-15-43. Monthly reports required in shortage areas. WPB may establish monthly delivery quotas for non-residential gas consumers; gas-fired equipment must have been in regular operation before 11-30-42, and for residential consumers before 12-2-42. Relief may be sought by letter to WPB by suppliers if essential to war effort; by others on Form WPB 3314. Preferred consumers and restricted areas lists substantially amended. Issued 10-25.

HEAT EXCHANGERS—L-172, as am. 10-26-43—Lengthy production and delivery schedule regulations, including reporting requirements, removed from order. AA-5 priority requirement for Group II critical heat exchanger orders unchanged. All references to Group I exchangers deleted. Issued 10-26.

LUBRICATION EQUIPMENT — L-314—Only AA-5-rated consumers' orders for lubrication equipment of retail value above $25 will be accepted after 10-31-43. No jobbers' orders accepted by manufacturer after 10-31, unless rated AA-5 or higher. Deliveries to jobbers on lower ratings prohibited after 11-20-43. Not applicable to replacement fittings of types used on automobiles, trucks, or buses. Jobbers and distribution outlets may apply for additional ratings on WPB-547 (old PD1X). Commencement of manufacture restricted after 10-31 to types specified in appended Schedules A-E. Continuation of manufacture restricted to same types after 12-20-43, with minor exceptions. MRO parts manufacture restricted on 1-1-44 to 150% per quarter of dollar resale value of MRO parts sold during corresponding quarter of period fom 7-1-40 to 6-30-41. Not applicable to parts for use by Army, Navy, Maritime Commission, WSA, lend-lease military forces. Detailed restrictions on use of metals in manufacture of lubrication equipment. Production restrictions apply against Army, etc. orders only after 1-19-44. Issued 10-21.

M-81, as am. 10-23-43—Restrictions as to use of cans amended; lubricating greases' packing quota (100% of 1942) extended to 1-lb. and 5-lb. size cans. Fiber or paper-bodied cans with ends made of sheets recovered from used cans excepted from restrictions, but permission to accept delivery of recovered used cans must be obtained on Form WPB 2825. Issued 10-23.

GENERAL SCHEDULING ORDER M-293—Miscellaneous Minerals Table (Table 7) revoked. Issued 10-25.

Table 8, as am. 10-22-43—Power Division Table amended, clarifying items on boilers and distribution transformers, and revising descriptions of each item on schedule. Issued 10-22.

Table 10, as am. 10-21-43—Safety & Technical Equipment Division Table amended, eliminating oxygen equipment and redefining carbon dioxide extinguishers. Issued 10-21.

M-354, Interp. 1—Purchasers of gasoline gum inhibitors forbidden to *require* postponement of delivery beyond 10 days after authorized month, but no definite limitation imposed on acceptance of delivery thereafter. 45-day authorization limit on consumption does not apply to export movement, nor to use outside U. S. Issued 10-28.

CMP Reg. 1, Interp. 20—The "procuring" claimant agencies under CMP are: War (including Ordnance) and Navy Depts., Maritime Commission, Aircraft Resources Control Office, Office of Lend-Lease Administration. Other claimant agencies are "non-procuring". Issued 10-26.

Office of Defense Transportation

LIMIT LOCAL SERVICE—Gen. Order ODT 6A, Am. 1—No local carriers services may be extended or inaugurated in a territory not served by any carrier on 10-25-43, unless written application is approved by the District Manager, Division of Motor Transport, ODT, as necessary to the war effort or to maintenance of civilian economy. Issued and effective 10-25.

GO ODT 17, Am. 6—Local deliveries restricted to services and routes already established on 10-25-43. Approval of exemptions granted by ODT only if necessary to war effort or maintenance of essential civilian economy. Changes in or consolidation of routes within established territory require no ODT approval if neither territory nor total mileage increased. Issued and effective 10-25.

GO ODT 18A—Supersedes GO ODT 18, Revised, as amended—Loading requirements substantially the same as in GO ODT 18. Unless freight car is loaded to marked capacity, or covered by a special direction or exemption, a certificate must be endorsed on shipping instructions specifying compliance with a provision of ODT 18, an applicable exemption, or general or special permit. Under certain circumstances not more than 3 consignors may consolidate in a single car separate consignments of carload freight originating at same point for shipment to not more than 3 consignees at not more than 3 destinations. Rail carriers must publish a specific tariff rule governing restowing or rebracing of carload freight at intermediate destinations to apply on carload freight shipped subject to consolidation privileges. Issued 10-23, effective 11-1. (Rebracing tariff-filing requirement effective 10-23).

Special Direction ODT 18A-1—Loading regulations on non-perishable carload freight—Specific rules as to weight and type of loading issued for numerous commodities, includ-

(*Continued on p.* 46)

The Editor's Page

Oil Shortage Intensified as "Experts" Quake In the Black Shadow that Threatens 1944 Election

WASHINGTON—THE GREAT CONCERN of the assistant presidents at the White House does not seem to be any fear over the serious shortage in oil supply, that threatens to wipe out not only A coupons, but B and even most of C as well.

Their great fear, as stated by Economic Stabilizer Vinson in turning down PAW's recommendation for a 35c crude price advance in order to head off the oil shortage, is that a price advance which would amount to only $2.493 per car owner PER YEAR, or less than 1c per week for a patriotic "share-the-ride" worker, would start "inflation".

For two pages at the end of the long "directive" Vinson goes into great detail as to how sacred the Roosevelt "hold-the-line order" is and how "a single breach may be widened by other pressure until the entire dam (restraining natural forces of tremendous power) is swept away by a flood of price and wage increases." He eloquently declares that "the (price) structure is to be maintained not by yielding here and there, but by resolutely standing firm against the threat of disaster implicit in every request for higher prices and wages."

Vinson even argues that the Roosevelt freeze order is so sacred that "there is a fundamental question whether that additional remuneration (Ickes' recommended price increase to get more oil) CAN BE GIVEN" as a matter of law. In the several discussions PAW and others have had with Vinson and his associated assistant presidents, some one evidently called Vinson's attention to a clause in the presidential pronunciamento that the Economic Stabilizer could "also issue such directives . . . as he deems necessary . . . to maintain and increase production and to aid in the effective prosecution of the war".

But this possible reason for deviating from the presidential hold-the-line-order is evidently so abhorrent to this ex-congressman and more recently ex-Roosevelt-appointed judge, that he sweeps it quickly aside with the statement that this clause was inserted only "as an incident of the Hold-the-Line-Order, to implement that Order—not to destroy it." That "Order" Vinson writes reverently with a capital "O".

In closing, Assistant President Vinson declares fervently: "To keep faith with unnumbered millions of wage earners, producers and merchants whose wages and prices have been stabilized, no increase can be granted in the price of crude in light of other practical measures available to insure an adequate supply of petroleum."

Thus the White House experts, who markedly know nothing of the oil business, dismiss the fears of PAW Ickes and Davies given by the latter to a congressional committee only the week before, fears that, while couched in cautious language evidently out of respect for a White House order not to dispute with other war agencies, nevertheless were summed up by PAW Davies in the significant and cautiously qualified statement that

"IF ALL the many factors involved in the success of these (PAW) programs COINCIDE PERFECTLY, there will be sufficient crude available to meet all essential civilian and military requirements that we can foresee through the year 1944, PROVIDING ALWAYS, of course, that some sudden upsurge in military demand does not unexpectedly occur."

The more you study this statement the more you believe there is a deep-seated fear in the minds of the administration's oil experts of even a catastrophic shortage in oil.

Vinson seems to rely on a brand new and yet-to-be-developed wild cat subsidy plan, in getting more sour oil from west Texas refined without disastrous corrosion to plants, in shipping more drilling and refining equipment to the Near East and in developing and importing more oil from Venezuela—a reliance which the government oil experts have not publicly or privately expressed and which certainly no oil man has yet announced.

Vinson remains silent on the congressionally admitted 50% takings of petroleum by the military and even the rumored 60% takings, which, if commercial hauling and farm oil supplies are not drastically reduced, will cut this country's civilian passenger car supplies from a present estimated 550,000 b/d of motor fuel to 70,000 b/d of a much worse motor fuel.

The Real Reason for Refusing Price Increases!

JUST what, then, might be the real reason for this denial of a better crude price and thereby denying to the country in quite reasonable probability sufficient oil supplies?

The "weight of the evidence" would seem to be the great love and affection for the Roosevelt "Hold the Line Order."

But are these many words of regard for that "Order" sincere or the product of lip service?

There is a shadow across this Vinson-no-price increase order, a shadow that is large and bulging, with long scraggly black eyebrows bristling off the top side—a shadow that covers all Washington and even the country as this week opens, a shadow of such blackness and extent as to almost extinguish the glow of all other celebrities of Washington, a shadow that seems to be able at will to chill the hearts of the White House occupants, to shrink the outlines of their greatness, if any.

That is the shadow of John L. Lewis, today—Monday as this is written—just about boss of all heat and steam power in these United States; the man who now is saying to the "hold-the-line" president and assistant presidents and to the entire country, that regardless of the war you pay my men so much or you go cold and weaponless.

Even as the chief of all this great country's Economy severely scolded the oil men and PAW for venturing to think of upsetting the sacred "Order" to freeze everything, Vinson was approving a major increase in wages to the followers of the Black Shadow, an increase almost equal to what the Black Shadow peremptorily demands. But as the oil men were reading their copies of the no-crude-increase message, the Black

READERS' comments and opinions will be much appreciated by Warren C. Platt, NPN's Editor and Publisher, Penton Building, Cleveland 13, Ohio.

Shadow is reported declining this generous desecration of the sacred "Order" because, he says, it's a few cents too little per hour.

Yet all the crude oil increase would have cost these and other well paid followers of the great Black Shadow is less than 1c a week, if they patriotically ride to their war work five to a car. Contrast this penny as an inflationary factor with the almost $10 a week the Economic Stabilizer is trying to push into the Black Shadow's hands.

Gentle reader, in the vernacular, the palaver of Vinson and the White House to the oil industry just does not wash.

That the public walks still more next year from lack of motor fuel, or sits in cold homes this and next winter, obviously is nowhere near as important as placating the big Black Shadow who has yet to lose a battle with the White House and who represents a lot of votes for 1944 and an evident Fourth Term Candidate.

Justice Department Has an Opportunity To Be of Real Service to the Industry

THAT THE DEPARTMENT OF JUSTICE is poking around again in the oil industry, as described by our Chief of Staff at Washington, Herbert Yocom, last week, is not pleasant information to a great many people in the oil industry because so many have learned from sad experience that the Department is not all that its name implies.

No American citizen should fear the Department of Justice. It should rank before the American people as a fitting and honorable arm of what the U. S. Supreme Court is supposed to be. But as the last dozen years have progressed the Department has slipped way down the scale. Most oil men who followed the Department's conduct of the "Madison Cases" will remember that the Department qualified more as the "Department of Injustice" because it violated so many of the rules and laws that should have governed its conduct. Two federal courts roundly condemned its misconduct and even the Supreme Court, where sat the professor who tutored two of the department's attorneys who tried the cases, could not avoid joining in the censure.

It is to be hoped that the Department will give heed to some of the criticism it has received in past years in conducting its present investigation into oil. If it does conduct itself properly, fairly, honestly and according to law, it will not halt any present war co-operation between government and industry, but will be of constructive service, either in clearing up any group's errors in interpreting the rulings that have been handed down the past two years for their conduct, or if the Department finds their conduct in accordance with good law then putting its O. K. on that conduct.

It would be much fairer for the Roosevelt Administration to have the Department of Justice keep an advisory check on all industries' cooperation with their government these days and guide those industries through the increasing intricacies of anti-trust and war law, than to wait until after the war, and then, because of some slip, technical or imaginary, make a one-sided and biased investigation and bring into court the men who were busy aiding the country.

All oil industry committees have had their procedure set forth in detail by competent attorneys in PAW and other government war agencies, and these committees have been making an honest effort to follow such procedure, difficult as it often times has been. These committees and the members of the staff of PAW and other war agencies are entitled to be treated like the honest and patriotic American citizens they are. If the Department thinks their conduct has not been strictly according to the rules, then it should tell them now clearly and constructively so that if necessary they may change that procedure.

At all events, the Department might well remember that it is on trial before the oil industry and the American people, represented by an alert Congress, no longer under the thumb of the New Deal.

The present investigation, it is understood, probably is the outcome of complaints from some Independent oil men as to the reported conduct of certain committees, and the Department's own consideration, by request of PAW, of a new draft of "No. 59" governing the allocation of products.

The Department is said to be studying whether oil committees have been "determining policies" and even carrying them out with only perfunctory study of orders by PAW.

Independents have not been satisfied that they have been getting a fair deal from some of the committees, nor have they felt that their advice was always solicited or even considered when volunteered. The secrecy with which these committees have enveloped themselves has been most conducive to suspicion and misunderstanding of their acts. That secrecy and the failure to put some or enough Independents on some of the committees kept the committee members from benefitting from full and frank discussion of the problems before them.

The Department of Justice can be of great service to the oil committees and to the staff of PAW if it investigates the situation thoroughly and fairly and tries to do an honest job of helping all these oil men, majors and Independents, to get their war machinery in the best of shape possible for the winning of the war.

Three Cheers! Col. Houston Joins OPA!

A NEW DEAL IS COMING to the rationing part of OPA and we'll venture it will be quite a bit different from the "New Deal" that opened up the rationing section two years ago.

This new, new deal, is the coming of a former oil man, who served the industry long and well during the troublesome days of the late oil code in the early 30's. Then he was loaned to the old P. & C. Committee to work on the industry's labor and personnel problems at Washington.

This newcomer to OPA is Col. Bryan Houston, for many years personnel man with the Standard Oil Co. of Ohio. He later was in the advertising agency business. The past year or so he has been in the army in the oil procurement section. Now, on the plea of OPA Chief Chester Bowles, he is on loan to OPA.

Col. Houston has a brother, MacLean Houston for many years vice president in charge of manufacturing of the United Refining Co., Warren, Pa. and well known refinery expert.

What Col. Houston is going to do in charge of all of OPA rationing we don't know, not having seen him since he left the oil business a few years ago, but we'll bet that whatever he does it will be common sense and practicable and that his mind will at all times be open to suggestions, just as the door to his office.

Col. Houston is another big improvement which has come to OPA since the Independent oil men of the country drove out the OPA autocrat last winter. OPA is a long way from being perfect but it is getting better, even though slowly.

Letters from NPN Readers

Asks Congress Boost Price

TO: Members of Congress. FROM: M. D. Hackett, of Elyria, O., Kentucky producer, Owensboro field.

I am enclosing an editorial bearing date of Sept. 17 from the *Messenger-Inquirer* published in Owensboro, Ky., relative to the oil situation which has confronted the producers for some time past. This editorial shows the trend of public thought throughout the country.

A very able article appeared in *Collier's* Sept. 11 captioned "The Truth About Our Oil Supply" by Frank B. Taylor an eminent authority on questions of this nature. This article was widely read and favorably commented on by those of unbiased minds.

Another comprehensive editorial, herewith enclosed from the *National Petroleum News*, Cleveland, O., Aug. 25, under the caption "Why Shouldn't Congress Punish the Creators of Oil Shortage for Negligence—or Worse?" clearly gives the facts underlying this important product. Notwithstanding the voluminous evidence furnished, showing the necessity for a price increase in crude oil the Washington authorities have taken no decisive action.

These citations are only a few from the public press showing what the people are thinking about. Owing to the data already presented to government officials no doubt all are fully aware of the situation confronting the industry and it is evident Congress appreciates the seriousness of the problem.

As stated in the *National Petroleum News* "The Biggest Subject before the oil industry today is the shortage of crude oil and it is the biggest subject before the country. It is affecting adversely not only our civilian life but also threatening our military operations."

It is very evident that OPA Prentiss Brown was ready to approve a price advance some months ago, as urged by Secretary Ickes, had not the President's "Hold The Line" order been issued about that time.

The price of crude oil still remains about 60% of parity, compared with other wholesale commodities as shown by the U. S. Department of Labor report several months ago.

It is hoped by the oil industry, particularly the independent producers, and by the civilian population also, that Congress will take the matter in hand and provide for an increase of at least 35 cents per barrel above the ceiling price at the earliest possible time.

What Independents Want to Know

FROM: Jack Jaquiss, President, Kansas Oil Men's Assn. TO: The Editor.

I have enjoyed reading your articles in the National Petroleum News for the past several years. We Independent Oil Jobbers have always felt that you have had their interest at heart and that you have exposed certain Government agencies in their efforts to put restrictions on us where they were not needed.

Approximately 2 years ago the Hon. PAW Ickes started crying WOLF, WOLF to the Oil Industry. And this method of misinforming the American people has caused us to doubt much what they tell us today.

I am informed today that there is a definite shortage in crude oil and that there is a further cut anticipated in the value of "A" and possibly "B" and "C" coupons.

The 7th of November a number of Independent Oil Men's Association officers are meeting with Bill Boyd in Chicago to have an open discussion on public relation problems in the war effort. It seems to me that all of us attending this meeting should have a true picture of the entire industry. Therefore I am writing you for any facts that might be of value to us during this meeting. Is it necessary for the Mid-West to have coupon value cut to 3 and 2 gal. value? Is it necessary for us to have gasoline rationing at all? Is it not true that to begin with we were told that we needed gas rationing so that we would not wear out our tires? Gas rationing because of the shortage of rubber! Gas rationing because of a shortage in transportation! Now what the Hell is this gas rationing for; to put the small Independent Oil Man out of business so that the majors can have it all their own way? They are making more money today than at any other time through government contracts, that we small men can't handle. Is the armed forces hoarding gasoline?

All information on a true picture of the oil situation will be very much appreciated. Thanking you very kindly for your anticipated answer.

° ° °

Editor's Reply—

I think I can answer your questions better by referring you to the editorial which starts on p. 15 of the Oct. 27 issue and which, with some of the news stories in the same issue, will give you a clear and exact idea of the present oil shortage situation. I say "exact" subject to the fact that I think there are some more figures as pointed out in my editorial, that the industry should have. Those figures all go to show a more serious situation than people generally realize.

In the same issue I would refer you to pps. 7 and 8 and 9 for additional information.

Also if you wish, refer to the previous week's issue and my signed story which starts on the front cover.

I think you could very properly point out at the public relations meeting at Chicago next month, that the average oil man is being kept in ignorance of facts which vitally affect his own business and that as American citizens, you are entitled to have those facts just as quickly as any major oil company executive gets them, but that you don't get them now. Hence, the major oil company has an advantage on you of a few days or a few weeks or a few months, or maybe eternally.

You might make the point that you are entitled to have representation on more PIWC committees as well as PAW committees, in order to get the same amount of information for the Independents as the major executives get for themselves, to say nothing of the value of your advice.

I hope to be at the Chicago meeting and will look for you. Thanks so much for writing me.

Your Pardon, Gentlemen!

FROM: W. A. Parker, secretary, North Carolina Oil Jobbers Assn., Raleigh, N. C. TO: The Editor.

We of the Carolinas are proud of our states and we resent the removal of our citizens without their consent, thousands of miles to the cold bleak Dakotas of the Northwest, whose climate appeals to us no more than ours appeals to them.

In the New York edition of *Oilgram* for Tuesday, Oct. 12th, you stated that Fred W. Herlihy, of Orangeburg, *S. D.*, had been elected President of the National Oil Marketers Association, and that Tom W. *McCradken*, of Henderson, *N. D.*, had been added to the Directorate, for which in each case we are thankful.

Fred W. Herlihy liked the South so well that he gave up his native state of Massachusetts to become a citizen of South Carolina and he would hate badly to be forced to give up the nice oil business he has developed there in order to be transplanted to South Dakota. And try as hard as you may, we in North Carolina shall see to it that you do not transplant the President of this Association, Tom W. McCracken (not McCradken as you had it) from good old North Carolina to North Dakota.

We don't doubt but what the Dakotas are also good states and that their citizens are as justly proud of them as we are of the Carolinas, but they don't know any more about growing tobacco, cotton and peanuts than we know about skiing, ice hockey, and how to keep from freezing to death.

Please Mr. Writer, return our loved ones to their home communities as quickly as possible.

Ed. Note: We blushingly return Messrs. Herlihy and McCracken to their native soil. We thought we had grabbed them when all backs were turned.

Lauds Comic Strip Technique

FROM: C. C. Mercer, 435 E. 51st St., New York City. TO: The Editor.

On p. I of the Oct. 6, 1943 issue of NATIONAL PETROLEUM NEWS there appears an illustrated article "PAW Comics Stress Vital Role of Refinery Workers", which concludes with the following sentences.

"To the best of PAW's knowledge, this is the first time that the comic strip technique has been employed in industry. Officials are eagerly awaiting results."

Permit me to call your attention to the fact that I developed this technique as long ago as five years and there are many people who can testify to this fact.

During the past few years I have had little opportunity to do much with this technique as I have been otherwise occupied . . . but I am quite certain that if it is properly handled it will prove highly successful.

As a matter of possible interest is the fact that I originated this technique in answer to an expressed need of educating employes in management's problems and over a period of time worked out continuities to cover some 30 or 40 different subjects.

There are so many things to be said in favor of this technique as a medium of education if certain technicalities are observed—that I hesitate to attempt to cover them in a letter. I am however very much interested in this particular development and would like to know more about it.

Ed. Note: Reader Mercer should write Gordon Sessions, director of public relations, Petroleum Administration for War, New Interior Department Bldg., Washington, D. C.

Urge Liberalized OPA Rule On Eastern Fuel Oil

Special to NPN

BOSTON—Atlantic Coast Oil Assns. Conference is urging its membership to support a recommendation made by its chairman, Lionel Jacobs, to OPA, for a change in the manner of handling applications for supplemental fuel oil rations. Mr. Jacobs, in a letter to Larry Vass, chief of OPA's fuel oil rationing division, suggested that, instead of dealers having to return coupons for applications to take to their boards, they be permitted to issue signed statements against this year's ration and balance unused.

Mr. Jacobs pointed out that the change would avoid recording out, re-recording in, cost of mailing, interference with system and possible delays in deliveries. It would also induce consumers who are holding up rations for adjustments they believe due them to deposit them at once and let the dealers go ahead with filling tanks.

These cars—the cars of war workers—must be handled with care if U. S. war production is to continue at a high level. To help keep cars rolling, Uncle Sam is paying for periodic war worker car inspections—preventive maintenance to uncover defects causing undue wear before it is too late

Government Foots Bill for Inspections To Keep War Worker Cars Rolling

By W. W. Weston
NPN News Editor

UNCLE SAM is in the car maintenance business in earnest, paying out hard cash for war worker car inspections in an effort to promote preventive maintenance. How big the total yearly bill is cannot be determined with any accuracy since the government is paying the bills along with general operating costs of war plants as well as through direct contracts.

In many cases the car-maintenance program is helping to ring service station cash registers more often.

The program has been in existence for more than a year, and it is growing continuously. It operates between the Army, the Navy and the Air Corps and their contractor—the factories turning out war materiel for them. Its objective is to keep war workers' cars rolling by doing everything possible to insure proper care.

Pays for Inspections

The government doesn't pay for any car repairs or buy any spare parts, but it does pay for periodic car inspections and it finances war plant transportation committees whose job, in part, is to see that the car owner takes prompt care of the defects discovered by the inspections.

One rubber company with a string of service stores (oil, gasoline, accessories, household appliances, etc.) has been quick to recognize the potentialities of the government program and has installed it not only at its own plant in Akron but is acting as "subcontractor" for other war plants—providing the maintenance service and handling the operation of transportation offices for them. This company's plan will be reported in a later issue.

The government car-maintenance program was born when it became obvious that the nation's automobiles would have to be specially cared for if they were to outlast the war. The biggest munitions plant in the world isn't worth five cents to the war effort if no one can get to it to work. And surveys had shown that over 70% of the men and women working in war plants use private automobiles to get to and from their jobs. At the same time, with only a limited number of replacements, cars were dropping off the roads at an alarming rate. ODT estimated 1,000,000 cars were scrapped in 1942; 1,500,000 would be scrapped in 1943; and 2,000,000 in 1944.

Teaches Preventive Maintenance

It was to keep as many of these cars in operation as possible and to conserve gasoline and tires that the government program was launched. The value of the program in the number of cars saved or miles of operation added so far is hard to estimate, but this much seems certain: it is teaching thousands of car owners the value of preventive maintenance as they've never been taught before.

Here is how the program works:

A manufacturer of say Army Ordnance materiel surveys the transportation needs of his workers. He determines how dependent upon private automobiles they are; how many share-the-riders are carried; how transportation might be provided in the event of a public transportation strike or if a certain percentage of the automobiles now in use by his workers wore out and there were no replacements. In other words he figures just how precarious is his situation. Then he estimates the cost of setting up a transportation office to promote and coordinate share-the-ride programs, to plan efficient routes of travel, to pass on applications for extra gasoline, to handle worker transportation in emergencies, and to deal with the work involved in a car-inspection program. He decides how deeply he must go into the question of automobile maintenance in order to protect his plant against a shutdown because workers couldn't get to their jobs.

Cost Averages $3 a Car

With a program mapped and the cost estimated, he goes to Army Ordnance for approval. The program approved, he is provided with the money to make it work.

The cost to the government averages about $3 per car per year—which the government considers cheap insurance—but the average cost between individual war plants varies, running from less than a dollar to $8 or so per car per year. This depends upon the individual war plant's needs. One aircraft plant on the West Coast probably gets more than any other company for this program—$350,000 a year.

The maintenance program is worked out through separate contracts drawn between the government and the war plant, or the cost is included in the operating cost of the plant—when on a cost-plus basis—rather than as a direct expense item.

Westinghouse Program

From the oil industry's standpoint, Westinghouse Electric & Manufacturing Co.'s plant at Mansfield, Ohio, has one of the most interesting programs. Westinghouse in Mansfield employs 4400 workers and 70%, or 3080, get to work by private automobile. Many of them

. . . in the Pacific

When you see frizzy-haired natives of the South Pacific handling drums of American high-octane gasoline, you have some idea of the kind of job our navy is doing to keep our longest lifeline open.

And when you realize that this gasoline — every drop of it — is as good as it was the day the drums were filled, you know the kind of job that Tri-Sure Closures are doing.

No matter how far our mounting offensive moves, America will "keep the drums rolling." And Tri-Sure Closures will help keep them rolling *safely* — with an hermetic seal that prevents leakage, seepage and waste.

De Luxe Bound Copy of "We Were There" Free Upon Request

The dramatic story of the part Tri-Sure Closures are playing in the war is told in "We Were There", a modern odyssey of history-making exploits in Africa, the Pacific, the Aleutians, Java and Alaska. A beautifully bound, profusely illustrated copy of the De Luxe Edition will be sent free upon request.

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TRI-SURE PRODUCTS LIMITED, ST. CATHARINES, ONTARIO, CANADA

drive to Mansfield from Bellville, Lucas, Shelby, Ashland, Loudonville, Galion, Mt. Vernon, Crestline, Plymouth and Lexington—distances of 10 to 20 miles.

Realizing that its employes constituted a substantial percentage of the population of Mansfield, Westinghouse, in drawing up its car-maintenance program, decided to turn the work over to local service stations and garages. To set up its own inspection shops, or to go into the car repair and accessory business (as some war plants have done, in effect), would take a large amount of business away from established Mansfield service stations and garages.

At the same time, Westinghouse was determined that the government's money should be well spent—for good inspections and not poor ones. So it discussed the plan with service station and garage operators individually and, before approving a station or garage as an official inspector, assured itself that proper equipment and personnel were available to do the right kind of a job.

Stations Have Edge

Westinghouse was more interested in having inspections made by service stations than by garages, the reason being that the company wanted its employes to have the fullest confidence in the inspections and not to feel that a recommendation for a new distributor, for example, might have been influenced somewhat by the fact that the garage making the recommendation had distributors to sell.

Stations, in order to qualify as official Westinghouse car inspectors, had to be equipped to inspect tires, wheel alignment, brakes (including the pulling of one front wheel), batteries, lights, radiators, ignition and spark plugs. Wheel-alignment equipment was not a required item—the procedure outlined by OPA for checking alignment was accepted by Westinghouse as sufficient for the purposes of the program.

With its stations selected and the program ready, Westinghouse announced the plan to its employes. Each was given an inspection form in quadruplicate and it was pointed out that the inspections were entirely free of charge. Employes could go to any one of the 24 authorized stations and garages listed in Mansfield or to any one of the 22 stations listed in surrounding towns where many of them live.

Committee Follows Up

Of the 4 copies of the inspection form, one goes to the employe, one to the Westinghouse treasurer, one is retained by the inspector, and one is sent to the Westinghouse transportation committee which follows up with the car owner to see that needed repairs or adjustments are made (at the employe's expense).

The average charge by the 24 stations and garages in Mansfield for an inspection is $1.65. Cars of all "A" card employes at the Westinghouse plant are inspected twice a year; those of "B" and "C" card holders three times a year. In addition, the Westinghouse transportation committee makes a spot check of 25 cars each day in the parking lot.

INSPECTOR'S COPY

No. 126

Transportation Inspection

Westinghouse Electric and Manufacturing Co.

(Date)

To _____
(Garage or Service Station)

_____ _____
Street Address City & State

In line with our agreement, please check car bearing license number_____,
as presented by our employe_____.

Indicate results of inspection below, and deliver original copy to car owner. Mail duplicate and triplicate copies to Transportation Committee, Westinghouse Electric and Manufacturing Company, Mansfield, Ohio. $_____

Signed_____
(Transportation Committee)

Inspection Record

Part Inspected	If OK, check (√) below	If not, indicate work or repair necessary below (Do not perform work except as directed by owner, at owner's expense).	DO NOT USE
Tires - r. front			
(Does not include Regular OPA Tire Inspection.) l. front			
r. rear			
l. rear			
spare			
Wheel alignment			
Brakes (Includes pulling one front wheel)			
Battery			
Lights			
Radiator			
Ignition			
Spark plugs			

Inspection completed_____, _____
(Date) (Signature of Garage or Service Station)

(Quadruplicate)

Inspection form, in quadruplicate, used by Westinghouse

When approached by Westinghouse on the program, a number of service stations offered to handle inspections free of charge, believing that the contacts and opportunities to get under the hoods and otherwise to inspect the cars would provide enough extra business to justify free inspections. The company, however, refused to accept free inspections for two reasons: (1) it wanted its employes to feel perfectly comfortable if they had their cars inspected and didn't make a purchase, (2) it believed that payment for the service would put a greater responsibility for a good job on the inspector.

Westinghouse is dealing individually with stations and garages in and around Mansfield, and new ones are being certified as official inspectors right along. The company wants as many as are equipped to handle the work in on the program so that its employes will have a free choice of where they want their work done. Firestone, in Akron, is operating its car-maintenance program on the same principle, but it went to the local dealer association and obtained a flat price for inspections from the association secretary. Thus all operators who are members of the association automatically became inspectors for Firestone employes. In some other cases, war plants are setting up their own inspection and service departments and sometimes supplying gasoline, oil, lubrication and repair services as well.

America's car crisis is ahead. Recruiting over 3,500,000 new workers for war plants during the coming 12 months, as the War Manpower Commission plans, and finding transportation for them when the load on public facilities is already over capacity, will be a terrific job even if all automobiles in the U. S. continue to operate without a failure. So the Services—the Army, Navy, Air Corps—are pushing harder than ever to see that war plant workers, particularly, care for their cars.

War plant car-maintenance programs, they believe, are the solution. How these maintenance programs are handled—whether the war plants themselves take over the inspection and servicing of cars or whether they turn the job over to oil marketers—is likely to make a bigger difference than ever in the size of the market for petroleum products, accessories and services that oil marketers can count on in laying future plans.

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PARAFLOW *has been supplied to the Petroleum Industry without interruption.*

PARAFLOW *has been going down in price through the years.*

Is it any wonder then that Paraflow is so widely used by the Oil Industry in the manufacture of low pour-point lubricating oils?

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Consulting and laboratory services are available to aid the Oil Industry in obtaining optimum results. The purchase and use of PARAFLOW are not affected by any existing Government restrictions.

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Among the Giant molecule products for better oils developed by us and the Standard Oil Development Company are:

PARATONE — Viscosity Index Improver
PARAFLOW — Pour Depressant
PARATAC — Cohesion Additive
PARAPOID — Extreme Pressure Additive
PARANOX — Detergents, corrosion and oxidation inhibitors

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REFINING NEWS and TECHNOLOGY

Gulf Coast 'Gas' Stocks Dip Despite Crude Run Boost

HOUSTON—Stocks of all grades of gasoline held by independent refiners on the Gulf Coast continued to decrease during the first half of October despite a 9000-barrel per day increase in crude oil runs to stills. Stocks of automotive gasoline held by Gulf Coast Refiners Assn. membership represented but 50% of stocks as reported at the first of this year

Stocks of all petroleum products on hand Oct. 15 totaled about 3,500,000 barrels and reflected practically no change from the previus report of Oct. 1, which indicates that with a 10% increase in crude oil to stills the refineries have made no addition to over-all stocks.

During the first half of October, the 11 operating refiners processed 1,491,400 barrels of crude oil which is at the rate of 99,400 barrels daily and indicates operations at 81.8% of rate capacity.

100 Octane Output Quadrupled Since 1942; 360,000 b/d Likely Figure for 1944

NPN News Bureau

WASHINGTON — Some idea of the tremendous amounts of aviation gasoline now being produced in the U. S. and projected for the future was given last week by PAW.

Supplementing Deputy PAW Davies' testimony before the Lea committee the previous week that it would be a substantial understatement to say present production was 400% as much as early 1942 figure, PAW said it would be "about eight times greater" within a few months.

To convert these general statements into actual figures, here's about what it stacks up to: 100-octane production as of Jan. 1, 1942, totaled about 45,000 b/d; four times that would put it today at about 180,000 b/d (a substantial understatement as Mr. Davies pointed out), and by this time next year it will be twice that, or 360,000 b/d.

1944 Goal Exceeded

Thus, it might be reasonable, on the basis of Mr. Davies' "understatement," to tack on another 100,000 b/d or so production to the 360,000 b/d figure, and arrive at a grand total of 460,000 b/d for October, 1944, which, of cource, is pure speculation, and not based on any authoritative information.

In its announcement regarding the 100-octane program, PAW also pointed out that present production exceeds the 1944 goal of ultimate requirements as set by the military and government authorities in the spring of 1942.

Altogether, Mr. Davies stated, about $900,000,000 is being invested in production facilities for 100-octane, the program considerably exceeding the synthetic rubber program in size, scope, and cost. Distinguishing the program from most other war production projects, which have been financed principally by the government, more than 75% of this investment is being made by the oil companies and the remainder by the Defense Plant Corp., Davies said.

Since Dec. 7, 1941, PAW stated, a total of 72 major 100-octane construction projects have been initiated, of which 32 have been completed, in spite of delays in getting necessary materials. The remaining 40 plants will be completed "within four months."

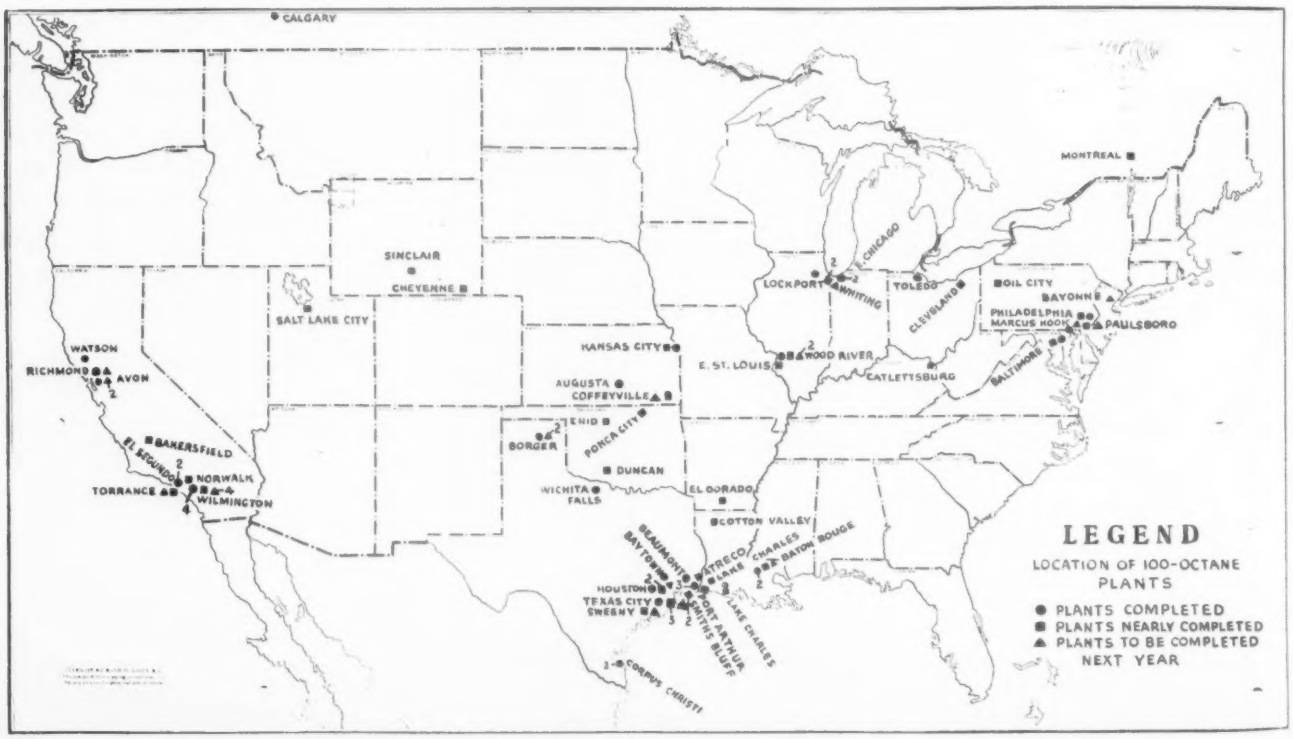
An additional 22 domestic plants have been scheduled in PAW's 1944 program and engineering work on these has been under way for some time.

In addition to the complete plants which have been or are being built, PAW has initiated more than 200 minor projects for changing or expanding existing facilities to increase 100-octane production, as well as production of other high octane aviation gasolines which are needed in tremendous quantity for military training.

Southwest Is Main Center

The projects, PAW said, vary from small conversion jobs costing less than $10,000 to complete plants, costing several million, and include 2 complete refineries. The new plants, which in nearly all cases are being erected within existing refineries, are scattered through-

Map Shows Locations of 100-Octane Gasoline Plants in U. S.



THE HANDWRITING IS IN THE SKY!

OUR enemies' calendar of conquest has turned backward. Under the ceaseless hammering of Allied air-power, their armies are on the defensive, their industry disrupted. Soon, that air-power will support the irresistible invasions that are yet to come—the prelude to final victory.

As this pattern of air-power develops, the importance of Houdry's part in it becomes clear. Consider this fact: during nearly two years of a war whose destinies have been largely determined in the air, a score of Houdry Process plants have produced 90% of *all* catalytically cracked aviation gas for the United Nations.

Today 22 out of the 26 catalytic cracking plants in operation are Houdry-licensed units, running dependably around the clock and smoothly across the months. Thanks largely to them, our fliers have had the finest fighting fuel in the world—plenty of it and on time. Thirty-seven additional Houdry and Thermofor Catalytic Cracking units are now being built under Houdry licenses.

Houdry Catalytic Processes and the Thermofor Catalytic Cracking Process are available to all American refiners, under license arrangements, subject to approval by the United States Government.

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out the country, with the heaviest concentration in the Southwest where 40% of the plants have been or are being built.

Mr. Davies, discussing the program, said:

"Both large and small refineries are participating in the program. Under the guidance of PAW, patents and engineering knowledge were pooled and in many cases engineering staffs of large companies which had developed processes for making 100 octane were loaned to to companies which before the war had not made the project.

"When the 1942-43 program is completed, 126 domestic refineries will be contributing to the production of 100 octane. Of these, 72 will make the completed product, while others will make components of the superfuel. Only 22 refineries in the U. S. were making 100 octane on Jan. 1, 1942."

From 8 to 16 months are required for construction of a 100 octane plant, Mr. Davies pointed out, depending upon the size and type of unit. The plants cannot be fully standardized because each has to be designed to fit into the facilities and conditions in the refinery in which it will operate. For instance, he added, the difference in the temperature of cooling water at Wood River, Ill., and Lake Charles, La., is sufficient to require marked changes in the engineering design of the units to be used at these localities. Differences in the qualities of various crude oils require major design changes.

List of New Plants

At the same time, PAW released the first list of new 100 octane plants and their locations. The list follows:

100 Octane Plants Completed

Atlantic Refining Co., Philadelphia, Pa.
Cities Service Oil Co., E. Chicago, Ind.
Continental Oil Co., Lake Charles, La.
Continental Oil Co., Wichita Falls, Tex.
Gulf Oil Corp. (2), Port Arthur, Tex.
Humble Oil & Refining Co., Baytown, Tex.
Imperial Oil Limited, Calgary, Alta.
Magnolia Petroleum Co., Beaumont, Tex.
Pan American Refining Corp., Texas City, Tex.
Phillips Petroleum Co., Borger, Tex.
Phillips Petroleum Co., Kansas City, Kan.
Richfield Oil Co., Watson, Calif.
Shell Oil Co., Inc. (3), Wilmington, Calif.
Shell Oil Co. Inc., Wood River, Ill.
Sinclair Refining Co., Houston, Tex.
Socony-Vacuum Oil Co. Inc., E. Chicago, Ind.
Socony-Vacuum Oil Co., Inc., Augusta, Kan.
Standard Oil Co. of California (2), El Segundo, Calif.
Standard Oil Co. of California, Richmond, Calif.
Standard Oil Co. of Louisiana (2), Baton Rouge, La.
Standard Oil Co. of New Jersey, Baltimore, Md.
Standard Oil Co. (Ohio), Toledo, O.
Sun Oil Co., Marcus Hook, Pa.
Texas Co., Lockport, Tex.
Texas Co., Port Arthur, Tex.
Tide Water Associated Oil Co., Avon, Calif.
Union Oil Company of California, Wilmington, Calif.

100 Octane Plants Nearing Completion

J. S. Abercrombie-Harrison Oil Co., Sweeny, Tex.
Ashland Oil & Refining Co., Catlettsburg, Ky.
Asiatic Petroleum Corp., Curacao.
Associated Refineries Inc., Duncan, Okla.
Atlantic Refining Co., Atreco, Tex.
Atlantic Refining Co., Philadelphia, Pa.
Champlin Refining Co., Enid, Okla.
Cities Service Refining Corp., Lake Charles, La.
Continental Oil Co., Ponca City, Okla.
Crown Central Petroleum Corp., Houston, Tex.
Eastern States Petroleum Co., Inc. Houston, Tex.
Frontier Refining Co., Cheyenne, Wyo.
General Petroleum Corp. of California, Torrance, Calif.
Great Southern Corp., Corpus Christi, Tex.
Lago Oil & Transport Co., Aruba, N.W.I.
Mohawk Petroleum Corp., Bakersfield, Calif.
National Refining Co., Coffeyville, Kan.
Pan American Refining Corp., Texas City, Tex.
Pennzoil Co., Oil City, Pa.
Phillips Petroleum Company, Kansas City, Kan.
Premier Oil Refining Co. of Texas, Cotton Valley, La.
Pure Oil Company (2), Smiths Bluff, Tex.
Republic Oil Refining Co., Texas City, Tex.
Root Petroleum Co., El Dorado, Ark.
Shell Oil Co. Inc., Montreal, Que.
Shell Oil Co. Inc., Wood River, Ill.
Sinclair Refining Co., Corpus Christi, Tex.
Sinclair Refining Co., Sinclair, Wyo.
Socony-Vacuum Oil Co. Inc., E. St. Louis, Ill.
Southport Petroleum Co. of Delaware, Texas City, Tex.
Standard Oil Co. (Indiana) (2), Whiting, Ind.
Standard Oil Co. of Louisiana, Baton Rouge, La.
Standard Oil Co. of New Jersey, Baltimore, Md.
Standard Oil Co. of (Ohio), Cleveland, O.
Texas Co., Port Arthur, Tex.
Union Oil Co. of California, Wilmington, Calif.
Utah Oil Refining Co., Salt Lake City, Utah.
Wilshire Oil Co. Inc., Norwalk, Calif.

100 Octane Plants To Be Completed In 1944

J. S. Abercrombie-Harrison Oil Co., Sweeny, Tex.
Asiatic Petroleum Corp., Curacao
General Petroleum Corp. of California, Torrance, Calif.
Humble Oil & Refining Co., Baytown, Tex.
National Refining Co., Coffeyville, Kan.
Pan American Refining Corp., Texas City, Tex.
Phillips Petroleum Co. (2), Borger, Tex.
Richfield Oil Co., Wilmington, Calif.
Shell Oil Co. Inc., Wilmington, Calif.
Shell Oil Co. Inc., Wood River, Ill.
Socony-Vacuum Oil Co. Inc., Paulsboro, N. J.
Standard Oil Co. of California, Richmond, Calif.
Standard Oil Co. (Indiana), Whiting, Ind.
Standard Oil Co. (Indiana), Wood River, Ill.
Standard Oil Co. of Louisiana, Baton Rouge, La.
Sun Oil Co., Marcus Hook, Pa.
Texas Company, Wilmington, Calif.
Tide Water Associated Oil Co. (2), Avon, Calif.
Tide Water Associated Oil Co., Bayonne, N. J.
Union Oil Co. of California, Wilmington, Calif.

Sun Dedicates Giant Aviation 'Gas' Unit; Ickes Lauds 'Magic Fuel's' War Role

By Henry Ozanne
NPN Staff Writer

MARCUS HOOK, Pa.—Sun Oil Co. dedicated its new aviation gasoline plant at its refinery here Oct. 27 with a program in which PAW Ickes, national and state officials, and top ranking Army and Navy heads took part—and a handful of Sun's own employes. The rest of the 3000 refinery workers stayed at their jobs so as not to lose even an hour's production in their wartime cause to which the new plant is their memorial.

And against the background of the huge, towering unit, mingled with the roar and hiss of its operation, was conducted the simple dedicatory service, and were spoken the brief words that marked the completion of this instrument of modern war.

Plant 15, the new unit, is built on a 123-acre tract, and comprises a 6-case Houdry catalytic cracking unit, an alkylation unit that is termed the largest of its kind, a gas recovery and stabilization unit and auxiliary equipment. The plant is a complete aviation gasoline refinery in itself and ties together all the aviation gasoline facilities at Marcus Hook. It cost $13,000,000.

In his address delivered in a great tent on the refinery grounds, PAW Ickes predicted that within a year U. S. output of 100 octane, which he termed "indispensable" for the success of our fighting forces, would be doubled. (The week previously Deputy PAW Davies, appearing before the Lea committee, cited figures indicating that present output of 100 octane is at least 180,000 b/d).

"I can't help wishing that all of my fellow-Americans could share with me the experience that I have been having." Mr. Ickes said. "There is something majestic and awe-inspiring about a great modern refinery; something about the sky-piercing towers, the dizzying catwalks, and the seeming chaos of pipes and pumps and cylinders that gives one a mingled sense of wonder and bafflement. But today there is more to the

Oil Industry Finances 80% Of 100-Octane Capacity

NPN News Bureau

WASHINGTON—Bruce K. Brown, assistant deputy petroleum administrator, told a gathering of Washington newspapermen prior to their visit to Sun's new aviation gasoline refinery at Marcus Hook that the oil industry's own money is creating 80% of its production of 100-octane gasoline. When all 100-octane plants in the program are going full blast, he said, their output will represent about $1,350,000,000 a year in government purchases of the products.

Pointing out that 126 out of 367 operating plants in the country are contributing to the 100-octane program, Mr. Brown said: "Every plant that's big enough to spit at is in the program in some way."

PICTURE OF A POLICY

Funny shape for a tire, isn't it? Only it isn't a tire. But it *is* something square in rubber—the Pharis policy of "taking care of our own."

This is the square method of allotting our regular accounts fair and equal allocations of Pharis S-3 tire, tube, cameback, bicycle tire and truck tire production under present conditions.

And now that Pharis is getting really squared away on production of the S-3 Tire, expect big things from this newest member of the family. Built in first-line molds, of finest quality cord construction, it gives typically fine Pharis performance.

Write or wire regarding the few choice territories still open for allocations.

THE PHARIS TIRE AND RUBBER CO.
NEWARK, OHIO

PHARIS S-3 TIRES

sensation than I have catalogued. Today the dominant emotion is pride—pride in the awareness that this huge plant, which the Sun Oil Co. is here dedicating, is not merely a highly efficient instrumentality to make gasoline: that it is a highly efficient instrumentality for waging a victorious war.

"There is one thing above all others that I would like to accomplish in my brief talk this afternoon, and that is to impress upon everyone who is listening the indispensability of 100-octane aviation gasoline. Enough, or too little, of this magic fuel can mean the difference between lives spared and lives lost, between victory and defeat. . . .

"Two years ago today, capacity for the manufacture of 100-octane was only about 40,000 b/d. And a thousand 4-motored bombers will use that much in a single 5-hour raid.

"Two years ago today, only a handful of refiners even knew how to make 100-octane.

"We knew that we had to start getting all of the 100-octane that we could out of the facilities that we had. There were several ways by which this might be attempted.

"One was to try to change in specifications, as, for example, permitting the use of a little extra tetraethyl lead.

"A second way involved chemicals with strange-sounding names such as iso-octane, isopentane, neo-hexane, hydrocodimer and other puzzling polysyllables. We told the oil people: 'Don't use any of those things for anything *but* 100-octane.'

"A third way was to see to it that all of the ingredients of 100-octane were mixed so as to get the maximum output.

"A fourth method was to remove operating bottlenecks by the prudent use of small amounts of equipment.

"There was still a fifth way that particularly concerned, among others, the Sun Oil Co., and catalytic cracking, in which it was a pioneer. This was the conversion of catalytic crackers to the manufacture of what the technical people call 'base stock,' which is a very high grade of automotive gasoline.

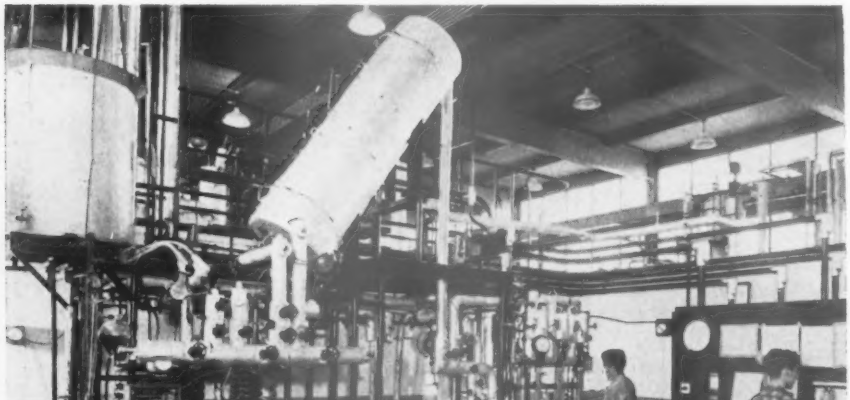
"During the years immediately preceding Pearl Harbor, this company had developed, through the use of the Houdry process, an automotive gasoline which Mr. Pew at least will assure you, if you will give him the chance, was the very finest that man had ever made. We got in touch with him and we said, in effect: 'We know that your company spent a lot of money developing this catalytic cracking process, but we need those cat crackers for aviation base stock.'

Pays Tribute To Industry

"I mention this, and other emergency expedients that were employed, because they are illustrative of the sincere and effective manner in which the oil industry has worked hand-in-hand with the government in meeting this urgent requisite of war. Refiners who had spent millions of dollars and many years on research to develop aviation gasoline processes made their knowledge fully available to all other companies in the interest of the Nation's good. They pooled facilities. They switched plans as necessity dictated.

"But there is still a huge amount of work to be done before we *have* all of the 100-octane that we are going to need. That, I trust, will be a challenge to those of you here who have worked on this catalytic cracker. I hope—in fact, I *know* that, when, or if, you go onto another aviation gasoline installation, you will give to that job all of the vigor and skill and enthusiasm that you have given to this one. I ask you to remember this: every day that you gain in bringing a plant to completion is a day nearer to the making of the fuel that may win a victory; every day that is lost in bringing a plant to completion, is a day's lost production—a day that may lose a battle, and cost priceless lives.

"As more and more plants come on stream, and as their capacity reaches ever higher, the chances of more gasoline for us civilians will become more and more remote. Out of the approximately 1,800,000 barrels of gasoline now made daily in the U. S., less than 1,200,000 barrels are available for civilian use. The rest—more than 600,000 barrels daily—are being taken by the military. Next year a still bigger cut will go to war. There is quite a widespread illusion that the more 100-octane that the refiners make, the more ordinary gasoline they produce. The exact opposite is true. Every gallon of 100-octane that is made means *less* ordinary gasoline."



This is a pilot plant in the Houdry laboratories. Operated in the same manner as large scale commercial plants, research conducted in this plant played a part in the designing of the mammoth Sun Oil Co. aviation gasoline unit dedicated last week at Marcus Hook, Pa.

Pew Sketches History

J. Howard Pew, president of Sun, sketched the history of the refinery from 1902 when he first came to work there, to date, paying tribute to "the men and women down through the years who have labored in this refinery and the men and women of the Sun Oil Co. elsewhere." He said:

"In these war years, we in the petroleum industry have been very fortunate that the man whom the Government selected to guide and direct our activities has shown real understanding and sympathy for our problems—problems with which you and I and all the other workers in the oil industry, as well as all those on our fighting fronts, are so vitally concerned. In the spirit of the times, this man could have undertaken to impose drastic regimentation upon our industry. Instead, insofar as it has been possible, he has seen fit to make his agency a co-operative adviser and a practical guide to the industry rather than its dictator. The result has been that the men and women of oil have used their initiative to work out their problems and have met the military requirements expected of them."

Others who spoke were Col. David G. Lingle, chief of the Aviation Petroleum Branch of the Army Air Forces; and Rear Admiral Ralph E. Davison, assistant chief of Bureau of Aeronautics, U. S. Navy. Lucy Monroe led a singing program. The entire program was under the auspices of the Sun's Labor-Management War Production Committee. Preceding the ceremonies, a group of 100 Washington newspapermen were conducted on a tour of the plant.

Sun's total facilities at the refinery here now represent an investment of $60,000,000 and facilities costing more than $36,000,000 are devoted solely to the production of aviation gasoline.

New TCC Unit in Operation For Gulf at Port Arthur

Special to NPN

PITTSBURGH — Gulf Oil Corp. has put into operation a Thermofor catalytic cracking plant at its refinery in Port Arthur, Tex., according to an announcement here by J. Frank Drake, company president. Butylenes to be used in the manufacture of synthetic rubber and as a blending component of aviation grade gasoline will be produced.

The Neches Butane Products Co. plant, jointly organized by Gulf, Socony-Vacuum, Texas, Atlantic and Pure Oil companies, will process the butylenes into butadiene. The blending component of aviation gasoline will be used by Gulf. The Thermofor unit will permit the production of a sufficient amount of the blending component to double the Gulf plant's present output of aviation grade fuel.

'42 Crude Runs Off 5%; 'Gas' Demand 10%

NPN News Bureau

WASHINGTON—Crude runs to stills dropped from the 1941 peak to 1,334,103,000 bbls. in 1942, a loss of 75 million bbls., or more than 5%, the Bureau of Mines reported last week in its annual petroleum statement.

Foreign crude runs were reduced by 36 million bbls. and domestic runs by 39 million. The gasoline yield dropped from 44.2% in 1941 to 39.8%, the residual yield rose from 24.3% in 1941 to 26.9%, and the distillate yield increased from 13.4% to 14.7%.

Total motor fuel demand fell from the record level of 695 million bbls. in 1941 to 624 million in 1942 or a loss of 10%. The decline in gasoline demand, the Bureau said, was primarily due to the curtailment of civilian automotive use resulting from rubber conservation and rationing in the Eastern States.

The total production of motor fuel was reduced from 701 million bbls. in 1941 to 609 million in 1942, a decline relatively greater than demand because of an abnormal decline of 15.4 million bbls. in finished gasoline stocks.

The combined total demand for distillate and residual fuel oils gained more than 6%. Due to higher yields, production increased despite the drop in crude runs. Residual stocks dropped 21.2 million bbls. and distillate fuel oil declined 4.4 million bbls. during the year.

Stocks of all oils amounted to 497,940,000 bbls. at the end of 1942, a drop of 58.5 million bbls. Stocks of refined oils dropped 46.8 million bbls. and stocks of crude dropped 11.9 million bbls.

c o a

Develops Super Component For Aviation Gasoline

Special to NPN

PHILADELPHIA — A new super aviation fuel concentrate, Dynafuel, made entirely from petroleum and especially processed to produce maximum power, has been developed by Sun Oil Co., according to announcement of J. Howard Pew, president. The new aviation fuel concentrate, says Mr. Pew, is 50% more powerful than U. S. standard 100-octane test fuel.

Dynafuel is never used undiluted but is blended with gasoline. It makes possible the production of greater quantities of aviation fuel, using those portions of crude oil which formerly went only into low-grade fuels.

The entire output of Dynafuel now is reserved for military uses, but after the war it "will bring the motorists a new, more powerful fuel for their automobiles," says Mr. Pew.

Announce Synthetic Rubber Made in Few Minutes

Special to NPN

LINWOOD, Pa.—A new process for the manufacture of synthetic rubber which, in pilot plant tests, produces the rubber "in a matter of minutes instead of hours", has been developed by Houdry Laboratories here. Whereas the standard process requires 12 hours, the new technique in experimental tests "produces rubber in but the fraction of an hour", Houdry chemists say. The process is now ready for commercial development.

Sufficient rubber already has been produced by the process to make a number of tires which are being road-tested. One tire on a taxicab went 7000 miles before failure and then it was the carcass that gave way, but not the synthetic rubber, one chemist asserted.

Butadiene and styrene are used in the new process, but the method of operation is different. The standard process employs a "batch" operation for mixing the butadiene and styrene to produce the latex, and various batch units are operated in a series to stimulate a continuous production of latex. In the new process, however, the production of latex is a continuous performance with a great saving of time. The butadiene and styrene are fed into a cylinder and come out as latex.

Atlantic Building Two Aviation Plants at Cost of 14 Millions

Special to NPN

PORT ARTHUR, Tex.—A new supply of high octane gasoline for Allied war planes will be produced daily early next year from two large catalytic cracking units now under construction by the Atlantic Refining Co. under authority of the War Department. One unit is located at the company's Atreco plant here and the other at its Point Breeze, Philadelphia, refinery.

The fluid catalyst type of high octane manufacture, will be used in both units. The 2 plants will cost Atlantic in excess of $14,000,000, and will bring the total investment of the company in aviation gasoline production equipment since the beginning of the war to more than $20,000,000.

The high octane gasoline which the American refining industry is furnishing the combat forces is a precision blend of high-grade base stock with two or more extremely high octane blending agents. Company experts say that the advantages of the fluid catalyst process are that it will produce as its primary product a high grade base stock of a quality superior to that obtained by former methods; it will make possible a higher yield from crude oils than could be had heretofore; and it may be operated with a marked saving in equipment.

As by-products of this form of operation, there will be produced charging materials from which the high octane blending agents are synthesized in other highly specialized processing units.

Two major factors had to be considered in planning these fluid catalyst crackers.

First, the technique of operating these new processes are as yet incompletely developed, because a marked reduction in the normal development time usually allowed for commercialization of a new process of such revolutionary nature.

Second, the disruption of normal crude oil transportation facilities has required refiners to process various grades of crude oil which were not a part of their ordinary planning, and since crude oils can differ so widely in character, difficulties were anticipated in bringing these new units to a stage of complete production in the minimum time after their operation had been started.

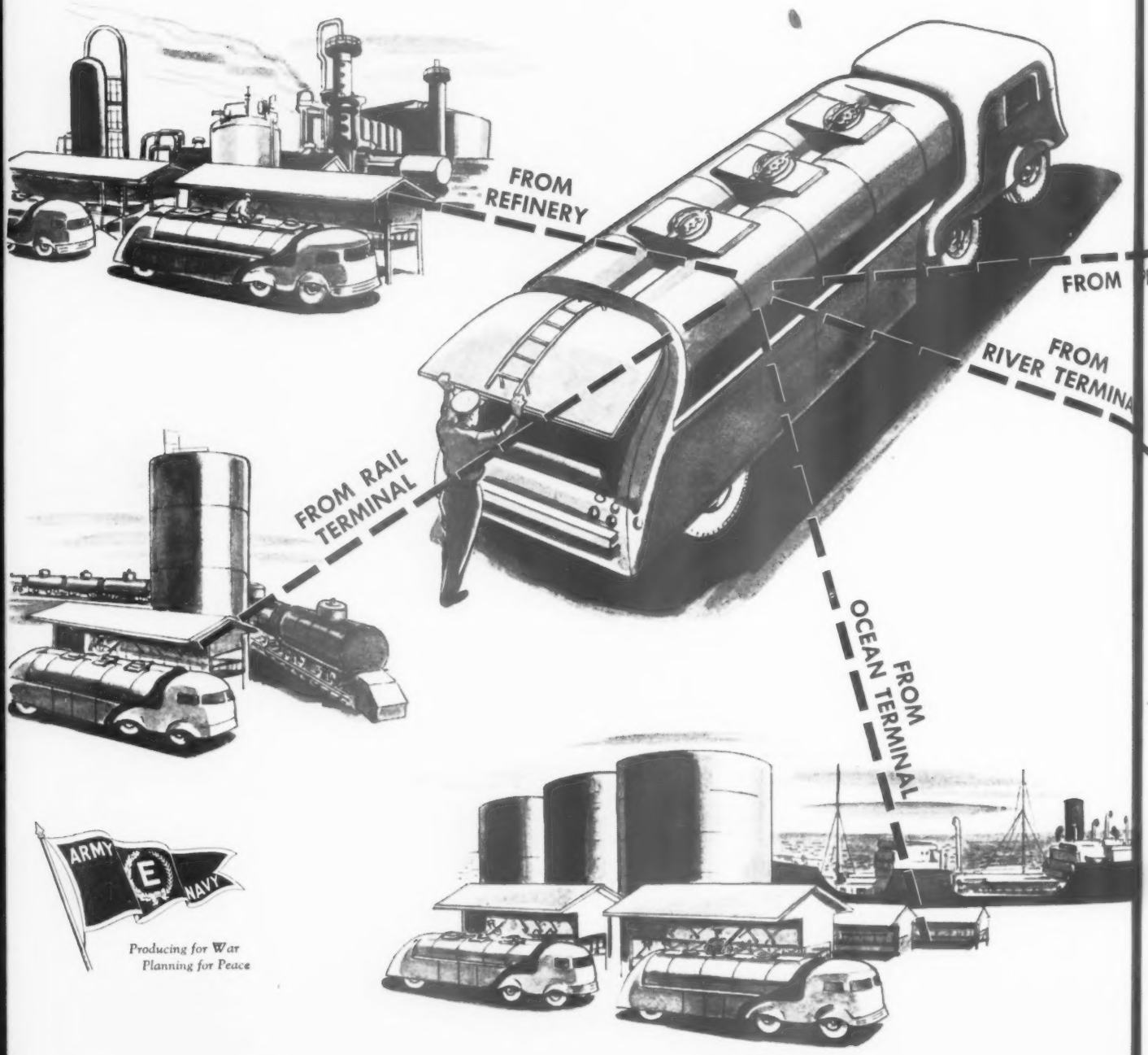
In order to overcome these handicaps

Production of Motor Fuel in 1942, By Months

(Thousands of barrels)

	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	1942	1941
Refinery gasoline:														
Cracked	30,324	26,006	25,629	23,504	23,130	22,423	24,080	25,387	23,882	24,905	24,433	23,225	296,928	344,013
Straight-run	22,725	19,320	20,769	18,419	19,573	17,404	18,954	19,192	19,088	19,997	19,116	18,891	233,448	279,272
Natural gasoline, etc.	7,731	6,991	7,255	6,415	6,877	6,716	6,962	7,187	7,167	7,429	7,314	7,675	85,719	84,290
Less sales of L.P.G.	710	577	556	572	483	498	536	502	579	663	687	832	7,195	6,281
Total Motor fuel	60,070	51,740	53,097	47,766	49,097	46,045	49,460	51,264	49,558	51,668	50,176	48,959	608,900	701,294

DISPERSAL HAULING...



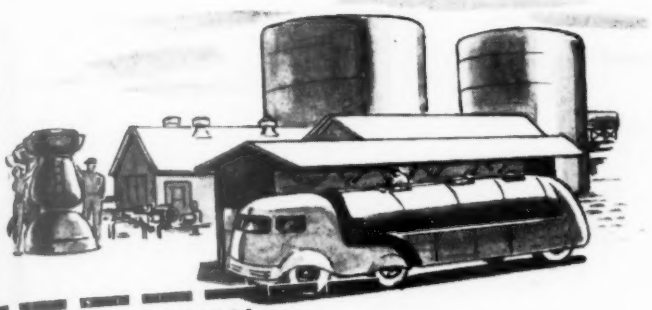
ARMY E NAVY

Producing for War
Planning for Peace

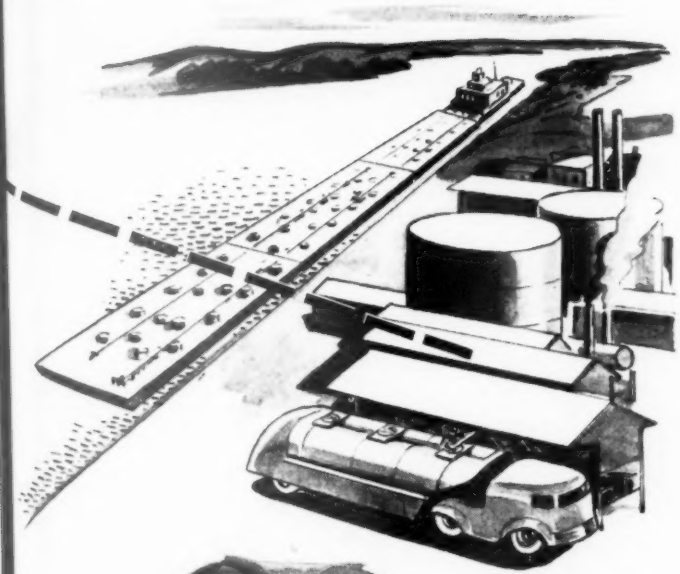
BUTLER BUILT

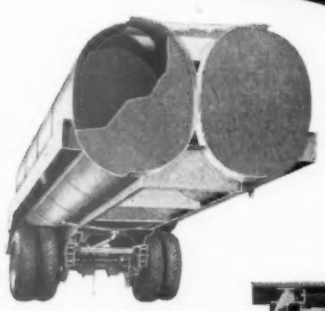
BUTLER MANUFACTURING COMPANY... Factories: KANSAS CITY, MO

TERMINALS TO SELLERS

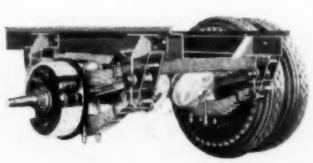


PIPE LINE TERMINAL





Butler Twin-Tank construction gives you the only transport with I-beam integral frame deeper than the tank body and a 20 to 1 factor of safety.



Two-Step Springing gives Butler Twin-Tank Safety Transport a soft, floating ride when traveling empty —frees it of road shocks, lengthens its life.

The products of oil are moving as they never moved before... by pipe lines, in barges, by tank car trains, in tankers, and by truck transports.

An evolution in oil transportation is taking place. Being determined now are such momentous questions as—To what extent will rail transportation be displaced? Can pipe lines compete with tankers? Are barge line facilities too expensive for inshore shipment? Will refineries move closer to markets?

No matter how the final outcome changes the pattern of distribution, one thing is certain—

THE TRUCK TRANSPORT IS UNRIVALED IN DISPERSAL HAULING

More oil products can be transported per pound of steel by truck transport; as a matter of fact, one pound or less of steel per barrel mile per day as against 2 lbs. for a 24-inch pipe line, over 3 lbs. for barge lines or 2½ lbs. for a 12-inch pipe line, according to competent authorities.

Well known is the record of single truck transports releasing from 10 to 20 tank cars for the long haul east. Now, records are being revealed showing how truck transports were largely responsible for increasing the average delivery nearly 3 times, cutting the number of bulk plants needed more than 25% and cutting the number of invoices per 1,000 gallons by two-thirds.

Many other cost cutting and distribution efficiency advantages stem from use of truck transports, whether they haul from ocean, pipe line, river, rail, or refinery terminals. From terminals these mobile pipe lines follow the highways direct to sellers.

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and also to contribute to the general fund of technical knowledge of the petroleum industry in the field of aviation gasoline production, the Atlantic company has installed and is now operating a large-scale "pilot" catalytic cracker in its Philadelphia laboratories.

Operated 24 Hours a Day

This equipment, built at a cost of $50,000, is a precision unit designed and constructed as a technical miniature of the large catalytic units under construction at Port Arthur and at Point Breeze. It is now being operated on a 24-hour schedule by a staff of skilled technicians and operators.

The "pilot" is being operated with the same stocks and under identical conditions that will exist in the big crackers when completed. From this constant experimentation, company technicians say they will be able to obtain information on variation in charge stocks and operating variables, and these studies will be turned over to the operating personnel of the two production units when they are ready to begin manufacture of the high quality, rigidly specified aviation gasoline. This information will thus permit quick capacity production in the big plants when they are started.

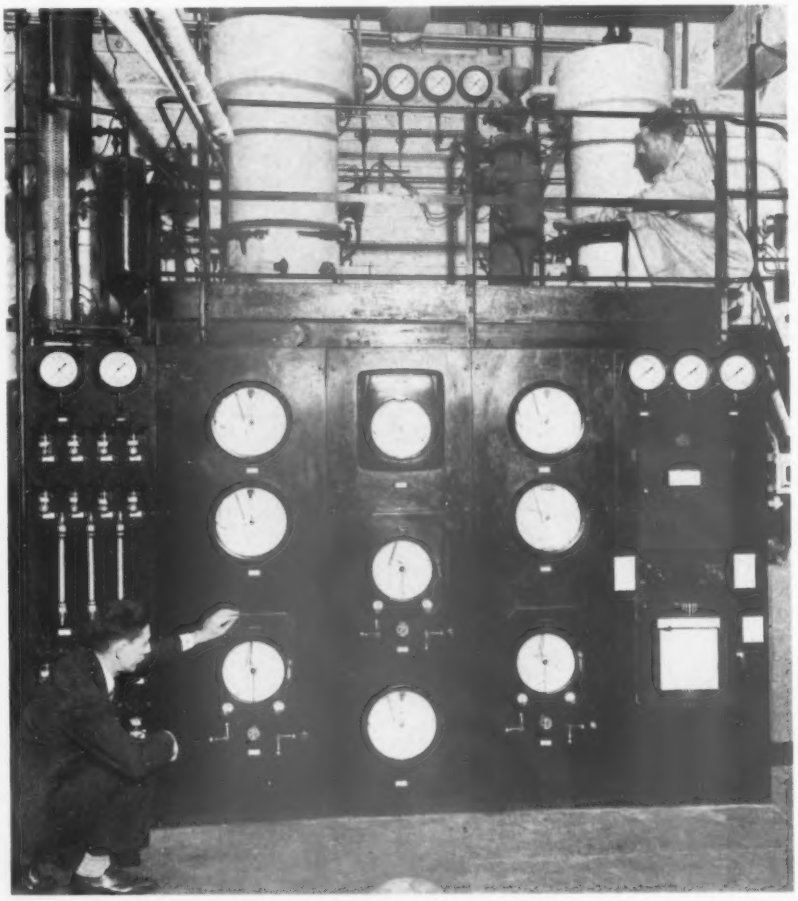
The output of the two new units will increase by thousands of barrels per day the already substantial amount of high-octane gasoline which the Atlantic company is producing for the armed forces. Earlier this year the company began operation of a new alkylate plant at Point Breeze to accelerate processing of aviation gasoline.

WPB Places 4 Gum Inhibitors Under Allocation Control

NPN News Bureau

WASHINGTON — War Production Board announced Oct. 11 that 4 chemicals used as gum inhibitors to prevent the accumulation of gummy substances in gasoline motors, will be placed under allocation as of Nov. 1 because of tremendous increase in their use for military gasoline and the resultant tight supply.

The 4 chemicals are known by the trade designations of "DuPont No. 5", "DuPont No. 6", "U.O.P. 4" and "U.O.P. 5". The maximum which may be accepted by any customer in any calendar month without WPB order is 10 lbs. of each chemical.



NEW 'PILOT' CATALYTIC CRACKER IN ACTION. This equipment, installed by the Atlantic Refining Co. in its Philadelphia laboratories is being used to test conditions under which 2 large catalytic crackers being constructed by the company will be operated early next year. The new units, one in Philadelphia, the other in Port Arthur, Tex., will greatly increase Atlantic's production of high octane for war planes. Their completion will bring the company's expenditures for aviation gasoline equipment since start of the war to more than $20,000,000

Claim Oil-Base Muds To Spur Drilling

NPN News Bureau

NEW YORK—Oil-base muds described as of great importance in wartime well drilling have been developed and announced by Shell Oil Co., Inc. The new drilling fluid is said be a significant contribution to the nation's stepped-up war oil production program.

Virtually all of the disadvantages of water-base mud have been overcome, it is said, with Shell's new oil-base material in which a crude oil or light fuel oil such as Diesel oil is substituted for water and a constituent such as calcium carbonate, for example—crushed oyster shells, is substituted for clay.

Research work done by Shell for a number of years has resulted in the development and patenting of oil-base muds which are meeting with marked success in actual field work. The muds have been perfected at Shell's Emoryville Laboratories and arrangements have been made with Halliburton Oil Well Cementing Co. for commercial distribution of the product. The muds cover a variety of types and are said to have great flexibility of use.

The superiority of the new oil-base muds, according to Shell, consists in the following characteristics:

1. Perhaps its most important feature is that of not sealing off the well when the drilling fluid is forced into the producing formation. The oil-base mud, regardless of the extent of the penetration by the fluid, does not flow back as oil.

2. The new muds possess the important property of thixotrophy—they form a jell to prevent settling of sediment, thus holding in suspension the sediment which in water-base muds drops to the bottom.

3. The new muds are said to be a much better plastering agent for the borehole since they are not pervious to water, as are water-base muds.

4. Oil-base muds make possible a more accurate determination of the fluid content of drilling cores and hence of the formations from which the cores were obtained, as against water-base mud which contaminates the core.

5. Oil-base muds eliminate danger in drilling through "heaving shale" layers which tend to collapse due to swelling on contact with water-base mud.

Shell reports that one completed California well which was to be abandoned as a dry hole was converted by the use of the new oil-base mud into a commercial producer.

Warren Builds Gasoline Plant

NPN News Bureau

TULSA—Warren Petroleum Co. is building the first natural gasoline plant in the Hawkins Woodbine oil sand pool of southeastern Wood county, Tex., according to company announcement. The plant, which will have a capacity of approximately 15,000,000 cu. ft., is expected to be in operation by February, 1944.

ON THE WARPATH!

INTERNATIONAL

NEW ENGINES

The government has authorized the manufacture of a limited quantity of International KR-11 Heavy-Duty Trucks, for civilian hauling in essential occupations. These big new trucks will have *brand-new 450-cubic-inch engines,* tested and proved in International Half-Track military vehicles!

U. S. highways everywhere have been converted into warpaths to haul vital petroleum products.

A good big share of these trucks are Internationals. Performance made them the largest selling heavy-duty trucks on the market. And the same toughness, dependability and economy of operation that put them out in front in peacetime keep them there today.

It's a big job trucks are doing—a job that *must* be done. That means trucks must be kept in tip-top shape. International civilian truck service—the nation's largest company-owned truck service organization—is now a *wartime* truck service . . . more efficient than ever.

No matter what your make or model of truck, let International Service keep your trucks rolling on the warpath to Victory!

War Bond Owners Are Stockholders in Victory

★

Add to Your Investment As Often As You Can

INTERNATIONAL HARVESTER COMPANY
180 North Michigan Avenue Chicago 1, Illinois

INTERNATIONAL TRUCKS

1200 Mi. Natural Gas Line Work To Start in January

NPN News Bureau

CHICAGO — Construction of the 1200-mile natural gas pipeline to be built from Corpus Christi, Tex., to Cornwell, W. Va., will begin in January of 1944, the time at which first shipments of pipe will go forward, according to announcement of Chicago Corp. The line will be built by Tennessee Gas and Transmission Co., Houston, which is controlled by Chicago Corp.

A. O. Smith, Milwaukee, will supply 900 miles of the 24-in. welded pipe, amounting to a 10 million dollar order. Remainder of the pipe will be supplied by National Tube Co., Pittsburgh, a subsidiary of U. S. Steel. Instead of the usual 9/32-in. thickness, pipe will be 0.25 in. thick which, it is estimated, will amount to a saving of approximately $1,228,000. Construction is expected to be finished in August, 1944.

° ° °

HOUSTON, Tex.—The Tennessee Gas & Transmission Co. which has been granted federal authority to construct a 1,250-mile 24-inch natural gas line from Corpus Christi, Tex., to near Clarksburg, W. Va., has established general headquarters in Houston.

Plans for laying the line are progressing rapidly, officials of the company said.

Gardiner Symonds is president of the company and other officials include Ray C. Fish, vice president in charge of operations; W. E. Mueller, treasurer; J. P. Bristow, chief engineer, and K. N. Fancher, general pipeline superintendent.

Roddewig Promoted by ODT

NPN News Bureau

WASHINGTON—Promotion of Clair M. Roddewig of Washington, D.C., from attorney in charge of local transport matters to assistant general counsel has been announced by ODT. He fills the position left vacant by the recent resignation of Hallan Huffman, who has gone to the Great Northern Railway as general attorney.

Before joining ODT in early 1942, Mr. Roddewig was with the legal division of ICC's Bureau of Motor carriers. In his new position, he will handle legal matters for the federal manager of the ODT-operated Toledo, Peoria, & Western Railroad.

Rail Haul of West Texas Oil to Mid-West Planned Early in December, PAW Says

NPN Staff Special

WASHINGTON—PAW plans to start West Texas sour crude shipments by rail into District 2 early in December if, as now expected, Defense Supplies Corp. agrees to make the movement compensable.

Indications are that the initial volume of tank car movement will be about 35,000 b/d, a PAW poll of mid-western refiners having already developed sufficient favorable replies to justify the expectation that the movement will approximate at least that rate at the outset.

DSC's answer to PAW's request that refiners be compensated for the added costs by tank car over the normal pipeline rate may be given within the next few days. Following the original PAW presentation in support of making the movement compensable, DSC called for more facts and figures bearing on the question of total costs to the government, etc., and will get these sometime this week, it is expected, thus clearing the way for a decision.

Sight Favorable Action

The belief in industry circles here is that the DSC decision will be favorable.

Meantime, as one further step in the effort to utilize the excess productive capacity of West Texas, PAW expects to start tank cars carrying at least 15,000 b/d of sour crude direct to East Coast refiners in mid-November.

War Production Board has approved the project of Atlantic Refining Co. for tank car loading racks at Midland, Tex., capable of handling 4 switches daily, on a basis of 76 cars to each switch. The new racks will be ready by Nov. 15, according to present plans, for the loading of cars in the District 1 movement.

With from 90-105,000 b/d of West Texas crude already moving into District 1 via the Big Inch pipeline, effect of the 15,000 bbl. additional movement by tank car will be to use up the last of the available East Coast refining capacity capable of running high sulfur oil.

Pipeline Progress Good

PAW reports that, because of difficulty in finding necessary labor, work is progressing slowly on the first of 2 new pipeline outlets for West Texas crude—Magnolia's new 333 mile, 12-in. line from Midland to Corsicana, nad that work on the second—Stanolind's Slaughter to Drumright project—was scheduled to start Nov. 3.

As of the first of last week, Magnolia had strung 40 miles of pipe on two 8-in. lines between Seminole, Tex., and Midland, and had welded 35 miles. Right-of-way is being purchased between midland and Corsicana, and pipe is coming from the mills, shipments having started Oct. 16. Project is scheduled for completion March 1, 1944.

Work on the Stanolind line, which will tie into Stanolind's trunk to the Chicago area, is being started on two spreads, and the number will be increased to 5 on Dec. 1. Pipe deliveries were scheduled to have started from the mills about Nov. 1, at a rate of about 8 miles per day.

The Stanolind line will be 385 miles long of 16-inch pipe. Initial capacity of 65,000 b/d can be stepped up to 116,000 b/d by the addition of 7 pump stations. Tentative completion date is April 1, 1944.

Magnolia's new line will parallel its existing 8-in. line. Capacity of pump stations of the 8-in. line will be stepped up and tied into the new project to provide a capacity of 42,000 b/d. By adding 3 new pump stations this can be stepped up to 60,000 bbls.

Effect of placing lines in operation, plus effect of tank car movements to both Districts 1 and 2 and shipments via the Big Inch, will be to enable production of West Texas crude at the maximum efficient rate; will bring total Texas production close to the estimated maximum of 2,000,000 b/d.

Southwest Emergency Pipeline Makes First Deliveries

Special to NPN

HOUSTON—The Southwest emergency pipeline has made its initial delivery of oil from Refugio to Houston.

The line, currently delivering oil at the rate of 50,000 b/d, will have a capacity of 75,000 b/d when all 5 stations, which are now completed, are put in operation.

The 150-mile pipeline, a project of the Defense Plant Corp., has been leased to the Defense Supplies Corp., but the Humble Pipe Line Co. is acting as agent for these 2 government corporations in constructing and operating the line.

The line, which has been converted to the transportation of oil by reconditioning a 14 and 16-in. gas line between Refugio and Pierce Junction, a few miles south of Houston, was purchased by DPC from the Houston-Gulf Gas Co. The carrier was authorized by PAW in order to provide an outlet from the Corpus Christi area when the diversion of tankers restricted distribution.

The gas line, which was originally connected with Dresser couplings, was taken out of the ground, cleaned and repaired, then was welded and tested with pressures of 550 pounds. In addition, a new 24-mi. section of 12-in. pipe was constructed from Pierce Junction to the Houston terminal of the Southwest emergency pipe line, a portion of the Galena tank farm which was rented from The Texas Co.

In order to deliver oil from the Corpus Christi area to the initial station of the line at Refugio, the Atlantic, Barnsdall, Humble and Texas company lines have arranged to reverse their movements in the Corpus Christi area.

In EMPIRE REFINERY METERS

These meters are made in all sizes from 5/8" through 6", and may be fitted with registers recording in gallons, cubic feet, pounds or other units. Registers of the straight reading type or circular dial (as illustrated) can be furnished.

The famous **EMPIRE BALANCED PISTON** used in all EMPIRE Refinery Meters

PURCHASERS of EMPIRE Refinery Meters gain an added measure of value that no other meter can provide. This "plus" is the extreme accuracy and durability developed only by the famous EMPIRE oscillating piston principle of displacement measurement.

The long life of all EMPIRE Meters and their low cost of upkeep are features as outstanding as their unequalled accuracy. There are hundreds of these meters in the field that have operated 10, 15 and even 20 years without need of a single repair.

EMPIRE Refinery Meters are a sound investment in measurement. They provide in full all the benefits of metering without costly losses resulting from inaccuracy, premature wear or mechanical failure.

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MANUFACTURERS OF THE MOST COMPLETE LINE OF PETROLEUM METERS IN THE WORLD

'Little Big Inch' Gets Tryout in Water Test; Two Pipelines for West Texas are Started

NPN News Bureau

WASHINGTON—The western leg of the Big Inch's little brother—the 20-in. products pipeline—swung into the home stretch last week with the start of water testing on Oct. 28 preparatory to testing of the line.

About 1,250,000 bbls. of water will be required to fill the western leg, which extends from the Beaumont-Houston area of Texas to Norris City, Ill. The filling operation will take about 12 days, after which pressure will be built up in successive stages, involving use of 4 pump stations at a time.

Test May Take Month

Testing of the line may take a month or longer, but the time requireed is so uncertain that PAW has not yet set even a tentative date for movement of the first batch of heating oil through the line.

Meantime pumpings through the Big Inch averaged 312,202 b/d during the period Oct. 16 through Oct. 22 from Longview, Tex., to Norris City. Tank car loadings from Norris City to the East averaged 321 cars or 69,658 b/d, while deliveries to the Ohio Line averaged 37,686 b/d. In that week pumpings from Norris City to the East Coast averaged 203,855 b/d, with 130,598 b/d delivered to refineries in the Philadelphia area and 73,892 b/d delivered to the New York area.

West Texas Lines Launched

Status of the various pipelines remaining in PAW's pipeline program, still uncompleted, is as follows:

Projects Nos. 6 and 10: War Emergency 20 in. products line from Beaumont, Tex. to the East Coast—Western leg: All pipe laid. In Baytown area, feeder line to Southport and Republic refineries at Texas City nearing completion. All other feeder lines completed. Survey for 60-mile 8 in. line from Beaumont to Lake Charles under way and construction work will begin early in November. All other feeder lines to refineries in Beaumont area completed. Thirteen stations between Baytown and Norris City under construction with several nearing completion. Norris City station also being built. Eastern leg: 633 miles of pipe strung and 603 miles laid. Pipe laying scheduled for completion in December and initial operations to Linden should commence in January.

Project No. 8: War Emergency 24 in. line from East Texas to New York-Philadelphia area—Western leg completed. Eastern leg: Present indications are that remaining stations, operating one unit each, can be placed on the line about Nov. 1 to increase throughput beyond Norris City to approximately 250,000 b/d. Seven tanks at Phoenixville completed and six others under construction.

Project No. 20: Construction of products pipe line from East Chicago, Indiana, to Toledo, O.—152 miles of pipe strung and 144 miles welded. Seven pump stations under construction, with four nearing completion. Erection of tankage at Toledo terminal started. Project scheduled for completion in December.

Project No. 21: Construction by Stanolind Pipe Line Co. of 385-miles 16 in. crude line from West Texas to Drumright, Okla.—Construction bids received from various contractors and work will start upon receipt of pipe. There will be five spreads, each averaging between 75 and 80 miles. Pipe scheduled to be shipped from mills beginning November 1 at rate of eight miles a day. Building of two pump stations begun and erection of tanks will start upon arrival of steel from Casper, Wyoming. Project scheduled for completion by April 1.

Project No. 22: Construction by Magnolia Pipe Line Co. of 381 milese of 8 in. and 12 in. crude lines from Seminole to Corsicana, Tex.—40 miles of pipe strung and 35 miles welded on two 8 in. loops between Midland and Seminole, Texas. Right-of-way being purchased for new 335-mile 12 in. line from Midland to Corsicana. Regular shipments of pipe scheduled to start from mill about October 16. Project scheduled for completion by March 1.

Ask Intrastate Rate Boost

Special to NPN

DENVER—Nine major motor truck carriers in Colorado have petitioned the Public Utilities commission for a horizontal increase of 15% on intrastate freight rates. Carriers were granted 5% increase over competitive rail rates last spring.

OPA has been granted a request for a "pre-trial" conference with the commission and the petitioners, to determine whether or not it will intervene in the case.

WPB Releases 1224 Vehicles

WASHINGTON—A total of 1224 vehicles were released during week ended Oct. 23 under truck rationing program, WPB announced Oct. 29.

Total included 239 light, 718 medium, 64 heavy trucks, 196 trailers and 7 third-axle attachments.

Fight on Auto Tax Diversion Gains Headway in States

NEW YORK—More legislation to prevent, abolish or reduce the diversion of highway funds was passed in the first 6 months of 1943 than in any similar period in the last 20 years, Automobile Club of America has reported. The pre-war trend toward protection of highway funds was accelerated by wartime factors, chief of which was the sharp drop in state gasoline taxes and motor vehicle registration receipts, making protection of remaining revenue essential. A second factor was the attempt of states to be financially prepared for prompt resumption of highway improvement programs as soon as the war is over.

Legislatures of 4 states, Connecticut, Maine, Pennsylvania, Washington, approved constitutional amendments prohibiting diversion of state automotive taxes from highway purposes. In Maine and Washington the proposed amendments will come up for ratification in 1944, while passage by another legislative session is required in Pennsylvania and Connecticut before the amendments go to referendum.

Legislatures of Arkansas, Indiana and Washington enacted statutes discontinuing all diversion from highway funds, while the legislatures of 4 other states enacted laws substantially reducing the amount of highway fund money that can be diverted to other purposes. These states are Alabama, Delaware, North Carolina and South Carolina.

14 States Bar Diversion

Elmer Thompson, secretary of the Automobile Club of America, said:

"In the past, 43 states have diverted automotive tax money from their funds, but in recent years there has been a complete reversal of this policy by most of these states."

Today 14 states prohibit diversion of highway funds by constitutional amendment. They are California, Colorado, Idaho, Iowa, Kansas, Michigan, Minnesota, Missouri, Nevada, New Hampshire, North Dakota, South Dakota, Oregon and West Virginia. Eleven other states devote their automotive tax receipts exclusively to highway maintenance, construction and debt service on highway bonds. In 5 states, although diversion still exists, the amounts taken from the highway funds have been reduced in recent years.

Increase Shown in Tank Car Hauls To East

NPN News Bureau

WASHINGTON—Tank car hauls of crude and products to East Coast averaged 757,530 b/d during week ended Oct. 23, compared with 748,823 b/d preceding week, PAW reported Oct. 27.

Actual count of cars in service to District 1 as of Oct. 1 showed 68,879. Total of 52 participating oil companies loaded 24,584 during week ended Oct. 23, as follows:

Allied	37	Globe	61	Royal Petroleum	152
American Bitumuls	17	Gulf	2466	Shell	986
Amsco	332	Hartol	130	Shotmeyer	7
Arkansas Fuel Oil	2	Hess, Inc.	65	Sinclair	993
Ashland Refining	71	Home Oil	4	Socony-Vacuum	2946
Asiatic Petroleum	90	Jenney Mnfg. Co.	36	Southland	10
Atlantic Refining	1852	Libby	10	Southport	161
James B. Berry Sons	6	Old Dutch	7	S.O. California	6
Cantelou	5	Pacific	38	S.O. Kentucky	60
Chalmette	19	Pan American	1391	S.O. New Jersey	5527
Cities Service	601	Petroleum Heat & Power	38	S.O. Ohio	119
Continental	310	Phillips	105	Sterling	1
Crown Central	52	Premier	2	Sun	2696
Daugherty	8	Primrose	3	Talco	22
Drake	7	Pure	60	Texaco	2158
Elk Refining	35	Republic	86	Tide Water	685
Freedom Oil	8	Richfield	68	Tiona	3
				Triangle	30

20 YEAR CHAMPION

Introduced in 1923, and leader without a break for 20 years, over 800,000 Leland gasoline pump motors were sold when war called a halt. That is Leland's pre-war record.

The war record of this unusually sturdy, trouble-free equipment shows unfailing operation month after month, at a time when replacement motors are severely restricted.

The war won—Leland gasoline pump motors will again be available—and still more advanced in design as a result of continuous research and development.

THE LELAND ELECTRIC COMPANY
DAYTON 1, OHIO

CURB PUMP MOTOR

Leland

FAN COOLED HEAVY DUTY BULK STATION MOTORS

'42 Crude Production Off 1%; California Has Biggest Increase

NPN News Bureau

WASHINGTON—Production of crude in 1942 totaled 1,386,645,000 bbls., a drop of only 1% compared to a reduction of more than 5% in total crude runs to stills, the Bureau of Mines reported Oct. 28 in its annual petroleum statement.

The relatively greater curtailment in refinery operations, it said, was due to a decline in the total demand for all oils and an abnormal reduction of 47,000,000 bbls,. in stocks of refined oils. Together, these factors more than offset the effect of a sharp drop in total imports that normally would have required an increase in domestic production.

Compared with 1941, the principal gains in crude production were 18 million bbls. for California, 14 million for Kansas, 14 million for Mississippi, 5 million for Michigan, and 3 million for Wyoming. Production declines of 26 million bbls. in Illinois, 22 million in Texas, 14 million in Oklahoma, and 8 million in New Mexico more than offset the increases and resulted in a decline in total crude production of about 16 million barrels.

The average value of crude at the wells, the Bureau reported, rose from $1.14 per bbl. in 1941 to $1.19 per bbl. in 1942. The number of producing wells in the U.S. increased from 399,960 on Dec. 31, 1941, to 404,840 on Dec. 31, 1942. The number of wells drilled for oil and gas dropped sharply from 29,070 in 1941 to only about 17,930 in 1942 while the number of dry holes rose from 24% of the total in 1941 to 31% in 1942.

Total demand for domestic crude petroleum fell from 1,421 million bbls. in 1941 to 1,396 million the following year. Production was supplemented by a decline of 9.5 million bbls. in crude stocks of domestic origin. Domestic and foreign crude stocks stood at 245,754,000 bbls. on Dec. 31, 1942, compared with 257,678,000 on Jan. 1.

Crude Stocks Show Increase Of 2,001,000 Barrels

NPN News Bureau

WASHINGTON—Stocks of domestic and foreign crude totaled 235,998,000 bbls on Oct. 23, compared with 233,997,000 bbls. the previous week. Bureau of Mines reported Oct. 29. Increase of 2,001,000 bbls. comprises increases of 1,949,000 bbls. and 52,000 bbls., respectively, in domestic and foreign stocks.

Nearly every area showed increase; largest were Texas, up 1,551,000 bbls.; California, up 269,000 bbls.; Louisiana, up 100,000 bbls.; Illinois-Indiana, up 80,000 bbls.; and Mississippi, up 58,000 bbls.

Former Oil Well Crewmen Are Sought in Manpower Call

Special to NPN

DALLAS, Tex.—American Assn. of Oilwell Drilling Contractors on Oct. 28 mailed a manpower questionnaire to all drilling contractors, asking for the names and addresses of all known former drilling crewmen now emplayed elsewhere.

The completed list of crewmen is to be submitted to WMC, which recently offered to negotiate for the return of the men to the drilling industry where they can best serve the war effort as oilwell drilling crewmen, Brad Mills, executive secretary of the association, said.

In compiling the list, he continued, it is not necessary for the contractors to know whether or not the men are willing to return to the drilling industry as WMC will determine that. "It is important, however, that every effort be made by the contractors to furnish the best possible list of former drilling employes," he said, "and to return the questionnaire at once."

Oklahoma Allowable Unchanged

Special to NPN

OKLAHOMA CITY—Oklahoma Corporation Commission has set November Allowable at 353,000 b/d, same figure as for October, according to Walker T. Pound, conservation officer. Allowable is 7000 b/d above PAW recommendation and includes 28,000 b/d for petroleum liquids other than crude.

Estimated average daily production of crude for October was placed at 328,500 bbls., and 28-30,000 bbls. for petroleum liquids other than crude. One new pool was brought under proration during the month.

Louisiana Allowable Cut

Special to NPN

BATON ROUGE, La.—Louisiana department of conservation has set November production allowable at 360,181 b/d , which is 238 b/d less than October allowable and 15,519 b/d under PAW certification. Allowable was split between North and South Louisiana fields in amounts of 77,333 b/d and 282,848 b/d, respectively.

U. S. Completes Study Of Rodessa Field; Report is Available

NPN News Bureau

WASHINGTON — A comprehensive engineering study of the big Rodessa oil field in Louisiana, Texas, and Arkansas has been compiled and published by the Bureau of Mines which establishes a working history of the development and exploitation of one of the most complex oil reservoirs in the U. S.

Objective of the report is to make available factual and statistical data on well performance in the Rodessa field and to show established trends of modern operating methods and practices in high-pressure, gaseous reservoirs developed under close engineering supervision.

The field was discovered in August, 1930, when a well drilled to a depth of 5506 ft. in Caddo Parish, La., produced gas in commercial quantities. Discovery of oil in July, 1935, at a depth of 6048 ft. "initiated an intensive development program of more than usual interest to geologists, engineers, and operators in the petroleum and natural-gas industry," the report states.

Consisting of about 24,500 acres of oil-bearing land developed by 1026 wells and 18,500 acres of gas-bearing land developed by 116 wells, the field was estimated to have produced 127,153,228 bbls. of oil to Jan. 1, 1942, or 72.2% of its anticipated 176,000,000 bbls. of recoverable oil.

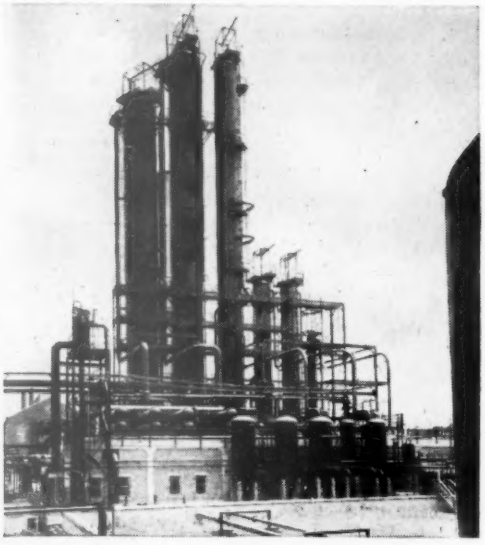
Tribute to Developers

Solution of the many production problems, including the complex nature of the different reservoirs, the large volumes of "free" gas under high pressures and temperatures in the upper part of the reservoirs, and the high gas:oil ratios of some of the wells during early production taxed the ingenuity of those responsible for the development and exploitation of the Rodessa field, the report comments.

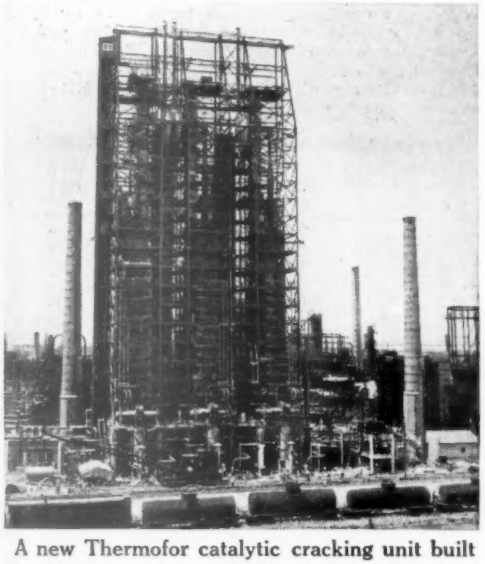
"The record . . . shows," it adds, "that the engineers and operators should be commended for their over-all efforts in promoting conservation of oil and gas in the Rodessa field and for the success they attained in developing and exploiting (this) large reservoir . . . on the flank of a long, broad anticline fault structure in which the oil-producing formations generally were underlain by water and usually contained large volumes of gas in gas caps and in solution in the oil."

A loan copy of Report of Investigations 3715, "Engineering Study of the Rodessa Oil Field in Louisiana, Texas, and Arkansas" may be obtained by writing to the Office of Minerals Reports, Bureau of Mines, Department of the Interior, Washington 25, D. C. Authors of the report are H. B. Hill, supervising engineer at the Bureau of Mines district headquarters at Dallas, Tex., and R. K. Guthrie, assistant petroleum engineer.

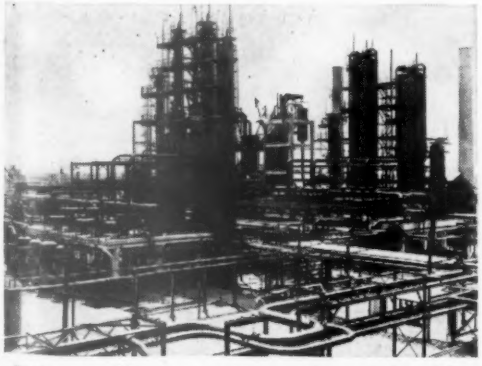
We hope this battle report gets to the front!



This Gulf unit makes toluene. Toluene makes TNT and TNT, placed in a shell and fired from an American cannon, heralds the downfall of America's enemies.



A new Thermofor catalytic cracking unit built by Gulf . . . turns out high octane gasoline for Allied planes . . . feed stock for synthetic rubber plants.



This new Houdry unit, recently completed by Gulf, produces another component of aviation fuel. It's helping U. S. and Allied Forces bomb our enemies.

NOT MANY DAYS from now the giant butadiene plant for making synthetic rubber at Port Neches, Texas, will be going full blast.

The story of this plant ought to make mighty cheerful reading for our fighting men.

For it's more than a story of a battle fought and won—the battle to get the rubber we must have to fight this War.

It's an illustration of how Americans at home are backing up those at the front. It shows how folks at home can take the toughest problems this War can hand out—and lick 'em to a standstill.

12 months ago, this butadiene plant . . . the biggest in the world . . . was on the drafting board. By the end of this year, it will be turning out synthetic rubber ingredients at the rate of 100,000 tons annually.

Certainly, the story of how five of the country's great oil companies worked as one to help design, build, and operate the Port Neches plant, is as heart-warming a tale as any that has come from the Home Front.

But there are others

Besides producing the vast amount of oil needed for our mechanized forces, our Navy, our gigantic war industry and our essential civilian use, the oil industry has tackled—successfully—two huge additional jobs:

1. The production of high-octane gasoline for our young giant of an air force;
2. The production of toluene for explosives.

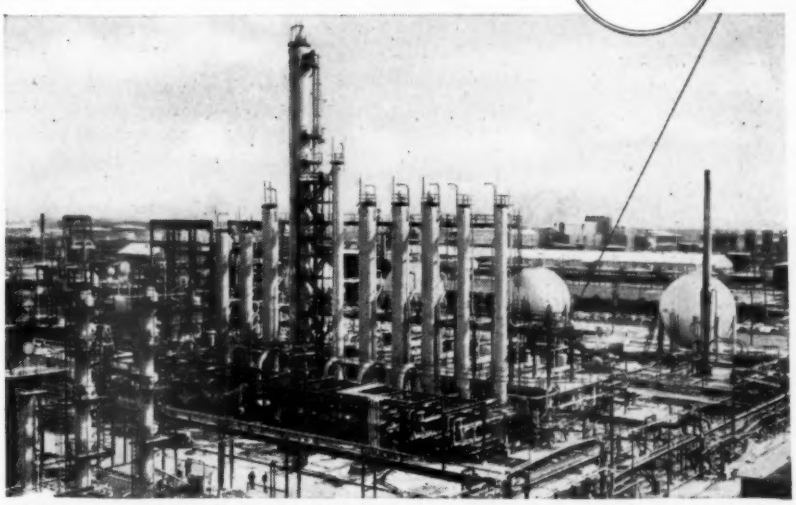
Supplying rubber for the wheels of our war machine—high-octane gasoline for its wings—explosives for its shells . . . can you think of three jobs more vital to victory?

As the Port Neches plant and the pictures on this page prove, all three jobs are being done—and well done. And for the part Gulf is privileged to play in the doing of them, we are both thankful and proud.

The Men and Women of Gulf—

BUY MORE WAR BONDS

GULF



This is one of Gulf's big alkylation plants making component parts of high-octane aviation gas by the carload. And America's high-test gas helps give our Air Force, the RAF, and the Russian planes a real edge over the Luftwaffe!

79% Allow Oil Check; Sales Average 1.15 Quarts, Test Reveals

By Herb Taylor
NPN Staff Writer

What is the average potential oil sale "per hood raised"?

To find a definite answer to that question and to put something in the hands of dealers more concrete than a sales talk, Skelly Oil Co. made a test on 1164 different cars of all makes, models and age.

Three stations were selected in different sections of Kansas City. Each station kept a record for 7 days of the number of cars crossing the driveways, the number of oil checks made, the number of motorists who refused permission to check the oil, the amount of oil sold on the driveway, and the amount of oil sold on drain and refill jobs by virtue of raising the hood and checking the oil.

Average Sale 1.15 Quarts

At the end of the check it was found that the average sale where the oil was checked amounted to 1.15 quarts. No oil, of course, was sold where hoods were not raised. The oil check survey, shown here, shows only 21% of the customers did not want their oil checked. This indicates that 79% of all motorists are willing not only to have their oil checked, but are willing to buy oil if shown it is needed.

The low percentage of hoods raised at station "A," Skelly explains, was due to that station having new help who had not yet learned the knack of getting under the hood. (See "How to Get Under the Hood," NPN Oct. 23, 1940, p. 46.)

Oil Check Survey
September 13 to 20

	Stations "A"	"B"	"C"	Total
Cars on Drive	377	357	430	1164
Hoods Raised	259	320	350	929
Refusals	118	37	80	235
% Hoods Raised	66%	89%	81%	79%
Qts. Oil Added	149	158	228	535
Qts. Sold for Refills	182	172	180	534
Total Qts. Oil Sold	331	330	408	1069
Average Sale Per Car (All Cars)	.89 Qt.	.92 Qt.	.95 Qt.	.92 Qt.
Average Sale Per Car (Hoods Raised)	1.28Qt.	1.03Qt.	1.16Qt.	1.15Qt.

Dilemma Solved

Another wartime cold weather problem is that of motorists who saved their ethylene glycol or permanent type anti-freeze as they were told to do last spring.

What to tell these customers when they come to stations with jugs, cans and bottles of last season's anti-freeze is a question being asked sales managers by dealers and station operators. This is true particularly with "green" help.

Standard Oil Co. (Ohio) has spelled out the procedure for these operators. In anticipation of no permanent type anti-freeze being available, or at least a serious shortage, many tests were made to determine how the permanent type solution could be reinforced for another winter's use. The results of these tests were made into the form of a bulletin for the use of station operators. This is as follows:

1. The strength of the left-over solution must be determined with hydrometer.
2. Consult the 1943 Standard anti-freeze chart and locate the quart capacity of the radiator.
3. On the bottom right of the Standard anti-freeze chart find the radiator capacity on the small conversion chart.
4. Follow the radiator capacity line across until figure nearest the present strength of solution is found. At the extreme top of this column will be found the number of quarts of anti-freeze now in the solution.
5. Dropping back to the radiator capacity line, move across the chart until you locate the temperature protection desired (—10, etc.), now again check at the extreme top for number of quarts necessary to insure that protection.
6. Subtract quarts listed above present strength from quarts above degree of safety desired.
7. The difference, PLUS ONE EXTRA QUART, is the correct amount of Standard anti-freeze to add to the old solution. The extra quart protects heater capacity and is added safety to compensate for mixing of different type anti-freezes.

To make it still simpler, a conversion table has been furnished dealers, with an actual problem and the solution. (See table below).

★ ★ ★

All the information you need to properly protect the customer's car will be found on the Standard Anti-Freeze chart, BUT YOU MUST TAKE THE TIME TO STUDY AND UNDERSTAND THE PROCEDURE!

In order to simplify the job for you we submit a worked out problem.

THE PROBLEM—A customer driving a 1940 Plymouth stops at your station. He has a can containing last winter's PermaGuard. What's the procedure to insure protection to at least —13° F.?

THE SOLUTION—

1. Test left-over solution. (+15° F.)
2. Determine radiator capacity of 1940 Plymouth. (14 Quarts)
3. Refer to "14 quart" line under "Radiator Capacity Quarts" on conversion table (reproduced below).
4. Find temperature reading on "14 quart" line which is nearest actual test of left-over solution. (+15° F.).
5. The number of quarts required to provide this reading is shown in top line. This means you have approximately 3 quarts of anti-freeze in the solution.
6. To insure —13° F., protection, find this figure for 14 quart radiator. It is 6 quarts.
7. The solution already contains 3, thus it will require 3 more to bring it to —13° F. To provide an extra margin of safety and to care for extra heater capacity, advise an additional quart.

Thus, the solution to the problem is to add 4 quarts of Standard anti-freeze.

Radiator Capacity Quarts	QUARTS REQUIRED TO GIVE PROTECTION TO TEMPERATURES, °F. SHOWN												
	2	3	4	5	6	7	8	9	10	11	12	13	14
10	16	5	9	23	36								
11	19	8	4	17	29								
12	20	11	0	12	23	34							
13	21	13	4	5	18	28							
14		15	7	3	13	23	32						
15		16	9	0	9	19	28	36					
16		18	11	3	6	15	23	31					
17		19	13	5	2	11	19	27	34				
18		20	14	8	0	8	16	23	30				
19			16	10	3	4	12	20	27	34			
20			16	11	5	2	9	16	23	30	36		
21			18	12	7	0	6	14	20	27	32		
22			19	14	8	2	4	11	17	23	29	35	
23			19	15	10	4	2	8	14	20	26	32	
24			20	16	11	6	0	6	12	18	23	29	34

For cooling systems larger than shown in table double the quantity for a cooling system one-half as large

Wartime Success Featurette

Down Texas way, Gulf dealer Clarence Wells, of Mineral Wells, who runs a station not nearly as large as many superdupers is not interested in the highest paying defense plant job in the country.

In the first place, he feels that he is just as essential in the war effort as the next man. Secondly, he's making more money than the average defense worker, with maybe a couple of banker's salaries thrown in.

Dealer Wells' *net profit* in the past year on batteries alone was $2250. In addition to that he made plenty by recharging, selling cables.

Then on top of that, Wells sold during the past year 252 new batteries by the very simple method of asking people to buy a new one when the old one was found faulty by testing.

"Why not save a dollar recharging fee by buying a new battery now rather than later when this faulty battery is sure to give out?" is Dealer Wells' clincher. And it works. He finds that approximately 1/3 of all batteries brought in for recharging have faulty cells. The owners of these are good prospects.

Wells makes a net profit of $18 per car through a painting arrangement he worked out with a painter who works days and wants to pick up some extra money at night. Wells sells the job (he always has a waiting list), furnishes the paint and other materials—about $9 per car—and collects $35 for small cars and $45 for the large ones. The painter works on 40% of the gross.

Manpower problems don't worry Wells too much. He goes to the army induction center and hires the wives of army men for driveway work.

When Someone Yells "FIRE!"

WHO MAKES THE NEXT MOVE?

What happens, if fire strikes in your plant?

Who grabs an extinguisher and hits the blaze hard, without panic, without fumbling? Who understands fire-fighting and the weapons with which fires are quickly snuffed out? *How many of your employees know how to handle an extinguisher?*

Fire extinguishers are easy to understand, and the basic facts about fire are simple. The best way to train your workers is by actual *demonstration*. Show them real fires, with extinguishers in action. Stage these demonstrations at your own plant, using your own equipment.

Walter Kidde & Company will send you "How To Teach Fire-Fighting." It tells how to handle demonstrations effectively, how to explain extinguishers and various types of fires. Write now for your own copy. We'll mail it promptly.

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Kidde PROTECTS LIVES
HIGH PRESSURE GASES • FIRE PROTECTION

OPA Offers 'Bail-Out' To Fuel Suppliers For Legal Shortages

NPN News Bureau

WASHINGTON—Details of a plan to enable primary suppliers and dealers to correct deficits or overages of ration evidences and bring their ration accounts into balance were disclosed in Fuel Rationing Director Joel Dean's "Fuel Oil Industry Letter No. 19", mailed to members of industry last week.

The plan, which will go into effect Nov. 1 as an amendment to Ration Order 11, is designed to give dealers a means to secure restitution for losses or shortages innocently incurred during the 1942-1943 season, and to eliminate some of the practices which have contributed to losses or shortages in the past.

To achieve the first aim, a new form—Form R-1120—is provided for dealers to report shortages (replacing Form R-549), and the forms used by primary suppliers for the same purpose—R-1119 and R-1119A—are being revised. The forms will be used after Nov. 1 for making application to replace unavoidable and unrecoverable losses. But their primary purpose is to provide suppliers an opportunity to balance their rationing accounts and dispose finally of any claims for losses that have accumulated since the beginning of the fuel oil rationing program last fall.

Dean Explains Need

Explaining the need for such a "bail-out", Mr. Dean said:

"The period of coupon credit during the first weeks of the program, the delay in issuing rations to many consumers, the lack of understanding of the program on the part of both dealers and consumers and the pressure of work and shortage of clerical help in dealer establishments last winter, have resulted in many dealers incurring losses or shortages of evidences or delivery receipts in addition to normal stock losses, despite the fact that they have carefully tried to operate in accordance with the fuel oil rationing regulations."

He emphasized, however, that the new procedure does not offer an automatic "bail-out" for everyone whose ration account is out of balance. Local boards will scrutinize carefully the information called for by the form and decide each case on its merits, and claims involving larger gallonage will be reviewed by OPA district offices. But if a supplier's statement shows that losses occurred through no violation of the regulations, provision is made for compensation.

To eliminate some of the practices that have caused losses in the past, the amendment will contain certain new provisions:

1. Primary suppliers or dealers may not make delivery to a consumer who is 15 days or more in arrears from date due in submitting evidences for fuel oil which has been transferred to him. Moreover a consumer is prohibited from purchasing on ration credit from any supplier if he is 15 days behind in ration evidences to any other supplier—this to protect the industry from the consumer who becomes delinquent in submitting evidences to his regular dealer and then transfers his purchases to another.

2. A primary supplier or dealer may, at his discretion, permit a consumer who is a ration bank depositor to submit a ration check for fuel oil purchases up to 15 days in advance of the date of transfer. Dealers may also make payment in advance to other suppliers in coupons and other evidences, as well as by ration checks, by as much as 15 days, at the option of the transferor. Suppliers may not use the evidences or checks received from such advance payment until the fuel oil has actually been transferred, and then only to the extent of the transfer.

Michigan Jobbers' Resolutions Sent to U. S. Officials

Special to NPN

DETROIT—Resolutions adopted by members of Michigan Petroleum Marketers Assn. at its fall conference in Traverse City, Mich., have been forwarded to various governmental agencies with explanatory letters.

To President Roosevelt and members of congress went a resolution asking that the price of crude be increased 35c per bbl. as recommended by PAW; that steps be taken toward the development of importation facilities; and that other action be instituted to assure an increase in the nation's supply of crude petroleum. It was further resolved that any increase in cost be passed on to the ultimate consumer.

The resolution forwarded to Petroleum Administrator Ickes urged that the proper governmental agencies be requested to draft and enforce regulations designed to insure a fair and equitable distribution of available petroleum and anti-knock ingredients among all members of the industry.

Stating that it is the belief of the membership of the Michigan Petroleum Assn. that violations in the sale of stove and lamp fuel and naphtha as gasoline had gone beyond any hope of solution by OPA, a resolution addressed to J. Edgar Hoover requested the intercession of the Department of Justice.

Other resolutions passed requested that the U.S. Manpower Commission declare the wholesaling branch of the petroleum industry essential nationally, and that OPA retain the present system of coupon banking instead of putting the proposed roll-back system of handling coupons into practice.

Auto Mechanic Schools Backed by ODT As Truck Reserves Drop

NPN News Bureau

WASHINGTON—Establishment in 32 states of vocational training classes in automotive maintenance, designed to assure a continuing supply of trained workers to maintain present equipment, was announced by ODT.

Cities and towns scattered over the country, the transportation agency said, are attempting to solve the problem of replacing automobile mechanics who have entered the armed services or war industries by organizing local vocational training schools, under the guidance of ODT and local maintenance advisory committees, in cooperation with the Office of Education and WMC.

With the country's reserve of new motor truck equipment now practically depleted, ODT emphasized that it is imperative that the motor transport industry "Keep 'em rolling" because of the scant replacements of vehicles due to military requirements.

This can be done, it continued, only through an efficient program of preventive maintenance, including periodical inspection, lubrication, tuning and checking of motor vehicles, and providing for an adequate supply of trained personnel.

Through the 142 district offices of its division of motor transport, ODT has organized maintenance advisory committees composed of local citizens representing every field of motor transport in their communities. In Memphis, Tenn., the committee inaugurated classes last May in automotive maintenance, utilizing local vocational training facilities, and these have proved so successful that similar courses of study have been extended nationwide.

During July, August and September, ODT said, classes in automotive mechanics were opened in 72 cities and are now turning out workers trained in at least one class of necessary maintenance work. Twenty-five more cities have completed arrangements and will soon start recruiting for schools in their communities. New and untrained personnel, both men and women, are instructed in one or more types of maintenance work, being paid during the training period by local industry needing such labor. Upon completion of one of the initial courses, some of which last only a week or so, the trainee is immediately hired for that type of work, either filling an existing vacancy or permitting more highly skilled mechanics to devote their time to more important work.

Issue New Oil Change Data

FLINT, Mich.—Buick Motor Division of General Motors Corp. has issued instructions to all its dealers, making changes in recommendations relative to engine oil changes, because of war-time driving conditions. The new oil change period recommendation for "A" and "B" gasoline card holders is every 500 miles; for "C" card holders, every 1000 miles.

THE ANSWER WAS 'NO'

(*Continued from p. 5*)

creased oil production would result. At a time when possession of tangible, above-ground oil is vital to the national existence, one cannot but be loath to gamble on the prospect of new oil discoveries. There is no guarantee that new fields will be discovered in significant size or number, whatever the price of crude oil. Shall the nation's future be hazarded on the prospector's luck?"

Can't Stake All on U.S. Fields

Besides, according to Mr. Vinson, "there is now no thought that the war effort must be staked on the chance that additional new fields of such magnitude will be discovered in this country as to enable domestic productive capacity to keep pace with the war's demand for crude oil.

"We are informed on high authority," he said, "that supplies of crude from all sources will be adequate at least through 1945. Use of foreign oil will assure that there will be no lack of oil to fight the war, and at the same time that this country's reserves will not bear so disproportionate a share of the burden of oil supply."

Arguing that "a barrel of crude oil in hand is far better than 2 yet to be discovered," Judge Vinson laid much emphasis on what he described as the "practical" ways in which oil supplies can be augmented without having to drill in unproven areas: full utilization of excess Texas productive capacity; increased use of foreign crudes; and increased drilling of developmental wells in proven areas.

Venezuela Crude Heavy

As for foreign oil, some point out that although Venezuelan production may be stepped up to 1,000,000 b/d by the end of 1944, a great portion of this oil is of the heavy type, whereas the need is for lighter oils for manufacture into war products. And, although Mr. Vinson "hopes" that the submarine menace has been finally vanquished, there can be no certainty as to this.

The Economic Stabilizer estimated that the cost to the buyers of petroleum products resulting from an average 35c price increase would be at least $500,000,000, based on present crude production and that 1/3 of this minimum annual cost would be "saddled" on the government.

Task of PAW Ickes now is to determine just where and how to spend the money and find methods of doing so, in the words of Economic Stabilizer Vinson, without: (a) increasing the cost of living; (b) burdening government or business with an impossible administrative task; and (c) dispensing public funds to those not engaged in exploratory activity or development of new fields.

What Mr. Ickes thinks of the assignment, he hasn't yet said.

Greetings

. . . to members of the American Petroleum Institute, welcome to Chicago and best wishes for a successful and enjoyable convention.

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Get and hold the business of more customers—get more profit per gallon—by merchandising a truly superior fuel in these days when gasolines are "all alike." Any gasoline processed with GUM-INHIBITING Lubri-Gas gives the user one to five more miles per gallon; freedom from gum and carbon deposits; protection against failure of cooling or lubricating systems; reduction of oil consumption, wear and repair; increased power; no knock. Write for PROOF!

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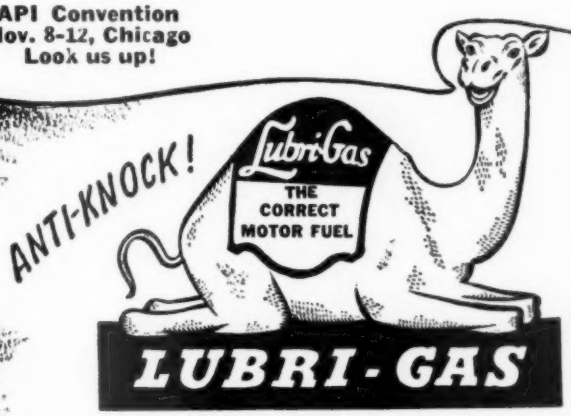

JOBBERS: Write for information—HOW you can sell Lubri-Gas processed motor fuels. "Puts You Out in Front of All Competition"

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Studies Show Efficiency of Metropolitan Distribution

Supplementary Surveys by Joint Use Group Find Small Room for Improvement in District 2; Voluntary Measures Outlined

AN EXHAUSTIVE SURVEY of all metropolitan areas over 500,000 population in District 2 shows that joint use of bulk plants would enable a saving of so few truck miles and so few man-hours as to make any such overall program inadvisable, according to a supplementary report just made by the District 2 joint use of marketing facilities subcommittee.

The survey of metropolitan areas was one of two supplementary studies made by the District 2 joint-use subcommittee following issuance of its main report in March. (*See NPN March 17, pp. 32-43*). The other supplementary study concerned possible savings in trucks and manpower through joint use of facilities in connection with heating oil deliveries.

In the first joint-use study in District 2, the only metropolitan area surveyed was Detroit, and in its main report the subcommittee pointed out that because conditions vary considerably between metropolitan areas it would be necessary to make an individual survey of each area if sound conclusions were to be drawn. Consequently, studies began on May 17 in Cleveland, Chicago, Milwaukee, Minneapolis-St. Paul, Kansas City and St. Louis.

Same Procedure Followed

The procedure used in making the original studies in District 2 was followed in the supplementary studies: Investigations were made of the resulting effect upon mileage and manpower in distributing the same volume to the same customers under new theoretical conditions.

Determined first were the truck miles and manpower required to deliver the total amount delivered in the area during April, 1943. Then, the truck miles and manpower that would have been required if no dump had been smaller than two-thirds of the storage capacity or the full truck capacity, whichever was smaller (Method 1-a). Next, accumulatively, the further saving that would have been effected if maximum use of large trucks had been made and if each company's truck scheduling and routing had been the efficient (Method 1-b). And so on, through Method 2 (inter-company use of bulk plants and terminals), Method 3 (exchange of trucks between suppliers), Method 4 (partial zoning-freezing of accounts), Method 5 (installing idle tanks to permit larger dumps), and Method 6 (arbitrary zoning—the blocking out of areas of supply for each company, etc.).

In the supplementary survey of metropolitan areas, however, no study was made of the effect of increased dump size (Method 1-a) or of internal efficiencies (Method 1-b) since the main survey had shown that these steps would save manpower and trucks in all areas, whether urban or rural. Likewise. the main survey showed that in urban areas the complete, arbitrary zoning of all accounts to the nearest bulk plant (Method 6), the use of presently idle dealer and consumer storage tanks (Method 5), or the partial zoning of accounts to the nearest bulk plant (Method 4) did not converve miles and manpower beyond the reductions possible by the interchange of trucks between companies (Method 3) and the joint use of bulk plants (Method 2), and, except in one area, Method 3 did not indicate any additional savings over Method 2.

In the early phases of its main survey, the joint-use subcommittee realized that no savings could be made in warehousing manpower through the joint use of bulk plants or the zoning of accounts and that the only saving derived would be a reduction in driving miles. Thus, the supplementary survey of gasoline distribution in metropolitan areas resolved into a study of potential savings in truck mileage and truck manpower through joint use of bulk plants.

Fairly complete information was secured from every type of marketer in each metropolitan area except Chicago, where 36 marketers representing about 10% of the volume declined to furnish the requested data.

Statistical conclusions drawn from the survey data are reported, in part, by the subcommittee as follows:

"The surveys revealed that each metropolitan area has its own peculiar, individual characteristics as to location and scatter of bulk plants, location of terminals and other primary supply points, size of trucks, and percentage of volume delivered to final destination directly from primary supply points. . . .

"The estimated percentage savings of truck miles resulting from the joint use of bulk plants varied from a low of 3.4% in St. Louis to a high of 14.6% in Milwaukee. The estimated reduction in man hours resulting from the joint use of bulk plants varied from a low of 1.4% in St. Louis to a high of 6.8% in Milwaukee.

"A comparison of the percentage savings for the 6 metropolitan areas is as follows:

TABLE 1—Estimated Reductions Which Might Result from Joint Use of Bulk Plants

	Truck Miles Per cent	Man Hours Per cent
Chicago	11.1	5.4
St. Louis	3.4	1.4
Cleveland	5.7	1.6
Kansas City	5.4	3.7
Milwaukee	14.6	6.8
Minneapolis-St. Paul	13.7	5.4

Reduction in miles through joint use of bulk plants is always greater than reduction in man hours, as only driving time is saved. Loading and stopping time are not affected.

"The purpose of considering the joint

Committee's Highlight Comments on Survey

"Based on data of the present survey, complete joint use of bulk plants in metropolitan Cleveland, Chicago, Milwaukee, Minneapolis-St. Paul, Kansas City and St. Louis would save annually marketing truck mileage equivalent to the life mileage expectancy of 5.9 tractor-trailer units of 2000-gal. capacity, and indicates a possible reduction of 37.7 men engaged in the distribution of gasoline. But the reduction in men is calculated only for truck manpower and does not consider the man hours necessary for the administration of a joint use plan, and, as a practical matter, the total manpower requirements might well be increased."

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"Where joint use of bulk plants shows an indicated saving in truck mileage, it might be assumed that approximately the same percentage of trucks could be withdrawn from service. However, in actual practice, about the same number of trucks as now in use would remain in service, although many of them would drive fewer miles. From the standpoint of conserving trucks, this mileage saving can only be interpreted in terms of truck life, reflected in Table 2. The number of trucks shown in this table as saved per year would not be saved the first or second year, but the saving would be in this annual order over a period of time. Or, stated another way, many of the trucks in use would have a longer service life."

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"In two metropolitan areas where this survey shows very small reductions in truck mileage through joint use of bulk plants (St. Louis—3.4% and Cleveland—5.7%), inter-company use of bulk plants already in effect represented 13.7% of the volume and 16.5% of the volume, respectively; that is, voluntary inter-company use of bulb plants has already approached the maximum in these areas."

use of bulk plants at this time is to determine whether such joint use would conserve trucks and manpower. For this reason, the estimated reductions as reported by its field survey men have been interpreted in terms of the number of trucks saved per year and the number of men which might be subtracted from the distribution of gasoline in the 6 metropolitan areas.

"A comparison of these figures for the 6 metropolitan areas is as follows:

TABLE 2—Estimated Savings Which Might Result from Joint Use of Bulk Plants

	No. of Trucks Per Year*	No. of Men Per Year†
Chicago	2.8	20.7
St. Louis	0.3	2.0
Cleveland	0.3	1.5
Kansas City	0.3	2.9
Milwaukee	1.4	6.5
Minneapolis-St. Paul	0.8	4.1

*Reduction in miles converted into number of trucks using 200,000 miles as the estimated life of a 2000-gal. tractor-trailer unit in metropolitan gasoline service.

†Reduction in man hours converted into number of men using 200 hours for working month.

"From an examination of Table 1, it is evident that the indicated percentage saving in truck miles is very low in metropolitan St. Louis, Cleveland and Kansas City, with somewhat larger savings indicated in metropolitan Chicago, Milwaukee and Minneapolis-St. Paul; while the indicated reduction in man-hours is relatively small in each area.

"However, in examining Table 2 . . . it is apparent that no material advantage would accrue from any general order requiring joint use of bulk plants throughout the respective metropolitan areas. Individual, voluntary inter-company use of bulk plants where specific savings can be effected is all that is necessary to bring the distribution of gasoline in the 6 metropolitan areas from an extremely high degree of efficiency to maximum efficiency."

In view of the conclusions drawn from the survey data, the joint-use subcommittee recommended that all marketers of gasoline in the metropolitan areas of Chicago, St. Louis, Cleveland, Kansas City, Milwaukee and Minneapolis-St. Paul should make immediate arrangements for inter-company use of bulk plants on a voluntarily basis where such arrangements . . . can develop specific savings of material value.

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Summaries of Gasoline Studies in Mid-West

Summaries of the studies of gasoline distribution in District 2 metropolitan areas were given in the subcommittee's report as follows:

Metropolitan Chicago

The supply comes from 7 refineries and terminals southeast of the city, 2 to the south, 2 to the southwest, and 4 to the west. There is little cross-hauling by transport movements to bulk plants.

22% of the volume is delivered direct. The supply sources are at a considerable distance from the main marketing areas and this condition, plus the relatively small size of the average marketing truck, makes it undesirable, from a mileage viewpoint, to increase direct deliveries beyond the present volume.

The bulk plants are well scattered, but the plant areas overlap in many instances. As a result, there is marketing truck cross-hauling, some of which could be eliminated by the joint-use of bulk plants.

Estimated Reductions by Joint-Use of Bulk Plants

47,105 miles 11.1%
4,137 man hours 5.4% @ 200 hours=21 men

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Metropolitan St. Louis

The supply comes from 5 refineries and terminals northeast and east (across the Mississippi) of the main marketing areas and 2 terminals on the west bank of the Mississippi in the south section of St. Louis. Cross-hauling of transport movements is no factor.

The supply sources are a considerable distance from the principal marketing areas. 55% of the volume is delivered by large trucks.

The bulk plants are scattered over the area. Most of the larger suppliers have more than one plant and have zoned deliveries around their respective plants. The volume of the majority of the one bulk plant suppliers is small and they principally deliver only to nearby areas with little or no marketing truck cross-hauling.

The present joint-use of bulk plants is 13.7% of the total volume and further joint-use would not substantially increase the savings in truck miles and man hours already in effect.

Estimated Reductions by Joint-Use of Bulk Plants

6,074 miles 3.4%
405 man hours 1.4% @ 200 hours=2 men

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Metropolitan Cleveland

Almost all of the supply comes from a refinery and a group of water terminals located in the center of the market. There is no cross-hauling of transport movements.

86% of the volume is hauled direct from the concentrated group of supply points by large trucks.

There are 11 non-terminal bulk plants in the area, 4 of which are used by more than one marketer, and 5 others are in the peripheral area, zoned to local deliveries requiring only small trucks. There are 2 bulk plants outside the area which make small deliveries into the city. Overlapping of bulk plant areas is only minor, and potential savings from joint use of bulk plants, both in truck miles and man hours, is insignificant.

Estimated Reductions by Joint Use of Bulk Plants

5,700 miles 5.7%
300 man hours 1.6% @ 200 hours=1.5 men

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Metropolitan Kansas City

The supply comes from 5 terminals and refineries, 4 of which are in the northwest section and 1 in the northeast section of the city. This situation would appear to create some cross-hauling of transport movements. However, arrangements are in effect which have eliminated most of this cross-hauling. The location of the terminals right in the city results in low transport miles.

40% of the volume is delivered direct, and this practice should be encouraged to the limit of the terminal capacities.

Most of the bulk plants are in the northwest section of the city, where their supply originates, and therefore the movements are mostly in the same general direction, which makes for a minimum of cross-hauling or back-hauling by marketing trucks.

Possible savings from joint-use of bulk plants are relatively small.

Estimated Reductions by Joint-Use of Bulk Plants

4,575 miles 5.4%
570 man hours 3.7% @ 200 hours=3 men

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Metropolitan Milwaukee

The supply comes from 4 terminals located close together near the center of the distribution, and from refineries in the Chicago area. The supply transport miles represent a large part of the total miles. Cross-hauling of transport movements is negligible because almost all of the bulk plants are north of the terminals and hence all movements come from a southerly direction.

38% of the volume is delivered direct. The many small marketing trucks, plus the congestion at the terminals, makes it desirable from a mileage viewpoint to transport remaining volume to the bulk plants for re-delivery.

The bulk plants are scattered through several sections, but some large areas have no plants. Many of the marketers have only 1 bulk plant, with wide delivery areas, which causes cross-hauling between plants and back-hauling on terminal movements. Some reductions in marketing truck mileage and man hours can be obtained by joint-use of bulk plants.

Estimated Reductions by Joint-Use of Bulk Plants

22,600 miles 14.6%
1,300 man hours 6.8% @ 200 hours=6.5 men

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Metropolitan Minneapolis-St. Paul

The main supply comes from 6 terminals,

Summary Data of Metropolitan Area Gasoline Surveys—April 1943

	Chicago	St. Louis	Cleveland	Kansas City	Milwaukee	Minn.-St. Paul
Reported Volume — Gal.	25,146,027	12,427,000	11,987,426	6,136,085	6,036,396	5,925,465
Number Marketers Reporting	98	31	20	38	44	56
Number Refineries and Terminals	8	8	10	5	4	7
Number Non-Terminal Bulk Plants	118	41	13	34	39	45
Total Number of Plants	126	49	23	39	43	52
Number Marketers Not Reporting	36	0	2	3	0	3
Estimated Percent Reporting	90%	100%	98%	95%	100%	95%
Weighted Average Truck Size	1,883	2,471	2,779	1,786	1,490	1,980
Total Transport Truck Miles	215,863	34,000	3,700	8,698	77,225	22,496
Total Marketing Truck Miles	209,787	144,299	97,300	75,754	77,390	65,081
Total Miles	425,650	178,299	101,000	84,722	154,615	87,577
Total Drivers Hours	75,999	28,542	20,100	15,393	19,139	15,352
Joint Use:—Miles	378,545	172,225	95,300	80,147	132,015	75,535
Est. Reduction	47,105	6,074	5,700	4,575	22,600	12,042
% Reduction	11.1%	3.4%	5.7%	5.4%	14.6%	13.7%
Hours	71,862	28,137	19,800	14,823	17,839	14,524
Est. Reduction	4,137	405	300	570	1,300	828
% Reduction	5.4%	1.4%	1.6%	3.7%	6.8%	5.4%
% Gasoline Delivered Direct	22%	55%	86%	40%	38%	22%
% Present Joint Use	Very Little	13.7%	16.5%	Little	0	0

2 in central Minneapolis, 3 grouped together in south St. Paul, and 1 north of the area; and 1 small refinery in eastern St. Paul. The terminal to the north of the area was the only one of real significance during the survey period (April 1943). This is a pipeline terminal, the remainder being water terminals. Most of the supply came from the pipeline terminal, hence cross-hauling of transport movements did not occur.*

Only 22% of the volume is delivered direct. This is due to lack of large trucks and limited terminal loading facilities.**

The bulk plants are well scattered over the entire area, but few marketers have more than one plant. Consequently the areas served by the bulk plants are fairly large, resulting in marketing truck cross-hauling, some of which could be eliminated by joint-use of bulk plants.

Estimated Reductions by Joint-Use of Bulk Plants

12,042 miles 13.7%
828 man hours 5.4% @ 200 hours=4 men

(* When the month of April 1943 was chosen as the survey period for all metropolitan areas, it was not appreciated that many of the Twin Cities water terminals would be dry, due to the end of the closed navigation season. Had the survey been made at an earlier or later date, there would undoubtedly have been found some cross hauling by transports due to the locations of the terminals. There would also have been found a larger per cent of the total volume delivered direct by transport.)

(** Since April, loading capacities have been substantially enlarged at several of the terminals and direct hauling increased proportionately.)

Intercompany Bulk Plant Use for Heating Oils Practical in Some Cities, Committee Finds

The domestic heating oil survey by the District 2 joint use of marketing facilities subcommittee was made in conjunction with the gasoline survey in metropolitan areas, reported above.

The heating oil survey followed the same procedure as the gasoline survey, except that zoning of accounts was considered. It covered the first 3 months of 1943 and included all domestic heating oil deliveries Nos. 1 through 6. Considered in the survey were all tank trucks used 50% or more of their operating time in domestic heating oil service.

As in the gasoline survey, wide variations between metropolitan areas was noted.

This is shown in the following table:

TABLE 3—Estimated Reductions Which Might Result from Joint Use of Bulk Plants or Zoning of Accounts

	Joint Use of Bulk Plants		Zoning of Accounts	
	Truck Miles	Man Hours	Truck Miles	Man Hours
Chicago	8.7%	3.9%	8.7%	3.9%
Minneapolis-St. Paul	27.5%	6.9%	41.7%	10.3%
St. Louis	5.5%	1.5%	31.5%	8.5%
Milwaukee	8.1%	1.8%	22.9%	4.5%
Kansas City	6.1%	3.5%	6.1%	3.5%
Cleveland	4.3%	1.5%	8.0%	2.5%
Madison (pilot survey)	6.7%	3.1%	10.5%	4.9%

• • •

The percentage figures converted into savings of specific numbers of men and trucks look like this:

TABLE 4—Estimated Savings Which Might Result from Joint Use of Bulk Plants or Zoning of Accounts

	Joint Use of Bulk Plants		Zoning of Accounts	
	No. of Trucks Saved per Yr.*	Reduction in No. of Men**	No. of Trucks Saved per Yr.*	Reduction in No. of Men**
Chicago	2.3	9.2	2.3	9.2
Minneapolis-St. Paul	4.8	13.9	7.3	20.8
St. Louis	0.7	1.8	3.8	10.5
Milwaukee	1.0	1.4	2.7	3.5
Kansas City	0.3	1.4	0.3	1.4
Cleveland	0.1	0.4	0.3	0.6
Madison (pilot survey)	0.3	0.7	0.5	1.1

* Reduction in miles converted into number of trucks, using 100,000 miles as the estimated life of a 1000-gal. truck in metropolitan domestic heating oil service.

** Reduction in man hours converted into number of men using 2400 hours for a working year.

The District 2 joint-use committee concludes that a study of Table 4 shows that "no material advantage would accrue from any general order requiring joint use of bulk plants throughout the respective metropolitan areas. Individual, voluntary inter-company use of bulk plants where specific savings can be effected is all that is necessary to bring the distribution of domestic heating oil in the 6 metropolitan areas and Madison, Wisc., from an extremely high degree of efficiency to maximum efficiency, so far as all phases of distribution are concerned, excepting only the application of the arbitrary zoning of accounts, which, of course, is not a normal procedure in competitive marketing."

The committee continues:

"While the material savings indicated from arbitrary zoning in Minneapolis-St. Paul and St. Louis appear large by comparison with the savings indicated for the other metropolitan areas, they do not weigh heavily against the required socialization of the domestic heating oil business to effect these savings. Further, the indicated reduction in the number of men is only that calculated for truck manpower and does not consider the man hours necessary for the administration of arbitrary zoning. As a practical matter, the total manpower requirements might well be increased."

Urge Voluntary Arrangement

The committee recommended that all marketers of domestic heating oil in the metropolitan areas of Chicago, Minneapolis-St. Paul, St. Louis, Milwaukee, Kansas City, Cleveland and in Madison, Wisc., should:

"Immediately make arrangements for inter-company use of bulk plants on a voluntary basis where such arrangements between companies can develop specific savings of material value."

It was further recommended that all marketers of domestic heating oil in the metropolitan areas of Minneapolis-St. Paul and St. Louis should:

"Immediately examine the location of all accounts serviced by their bulk plants and make inter-company arrangements where practical, for delivery to remote and scattered accounts by truck of other bulk plants having more concentrated distribution in the areas where these accounts are located."

Both supplementary reports of the District 2 joint use of marketing facilities subcommittee were signed by its chairman, H. T. Ashton, of Socony-Vacuum Oil Co., Inc., at St. Louis.

Jack W. Daker, Cleveland, of Standard Oil Co. of Ohio, served as field director of a group of 18 men loaned by District 2 oil companies to make the supplementary joint-use surveys on gasoline and heating oil.

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Summaries of District 2 Heating Oil Studies

Following are summaries of studies of heating oil distribution in District 2 metropolitan areas by the District 2 joint use of marketing facilities subcommittee:

Metropolitan Chicago

The supply comes from 7 refineries and terminals southeast of the city, 2 to the south, 1 to the southwest, and 4 to the west. There is little cross-hauling by transport movements to bulk plants.

Less than 3% of the volume is delivered direct. The distances to the terminals and the relatively small size of the marketing trucks would make further direct deliveries costly in terms of truck miles and man hours. There are many bulk plants in the area and many marketers with more than one plant. However, quite a few of the bulk plants deliver over a wide area and there is marketing truck cross-hauling, some of which could be eliminated by joint-use of bulk plants.

Estimated Reductions by Joint-Use of Bulk Plants

225 913 miles 8.7%
22 059 man hours 3.9% @ 2400 hours=9 men

The domestic heating oil accounts are sufficiently well concentrated related to the number of suppliers in each zone so that between-account mileage is small. Zoning of accounts would therefore bring about an infinitesimal further reduction in miles, or none at all, and probably would require added man hours.

Estimated Reductions by Zoning

225 913 miles 8.7%
22,059 man hours 3.9% @ 2400 hours=9 men

• • •

Minneapolis-St. Paul

A substantial portion of the supply comes from 6 terminals, 2 in central Minneapolis, 3 grouped together in south St. Paul, and 1 north of the area; and from 1 small refinery in eastern St. Paul. Most of the terminals' supply came from the 3 St. Paul terminals during the survey period, although tank car receipts accounted for an appreciable volume.

The principal supply sources are a considerable distance from the main marketing areas. Direct hauling from the terminals in relatively small marketing trucks would therefore be wasteful.

The bulk plants are well scattered over the entire area, but few marketers have more than 1 plant. The plant areas are quite large and there is an appreciable amount of marketing truck cross-hauling, much of which would be eliminated by the joint-use of bulk plants.

Estimated Reductions by Joint-Use of Bulk Plants

482 966 miles 27.5%
33,350 man hours 6.9% @ 24,000 hrs=14 men

Because the bulk plant areas are large, there are many suppliers serving each neighborhood. Therefore, the zoning of accounts to be delivered by trucks from the nearest bulk plant would result in substantial savings above

those calculated from the joint-use of bulk plants.

Estimated Reductions by Zoning

730,458 miles 41.7%
49,856 man hours 10.3% @ 2400 hrs.=20 men

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Metropolitan St. Louis

The supply comes from 4 refineries and terminals northeast and east (across the Mississippi) of the main marketing areas, and 1 terminal on the west bank of the Mississippi in the south section of the city. There is very little cross-hauling of transport movements.

The supply sources are a considerable distance from the main marketing areas. Direct hauling from the terminals in relatively small marketing trucks would, therefore, be wasteful.

The bulk plants are well scattered over the area and several of the larger suppliers have more than 1 plant. Six of the larger suppliers, however, deliver over the entire area from single plants, resulting in cross-hauling by marketing trucks, some of which could be eliminated by joint-use of bulk plants.

Estimated Reductions by Joint-Use of Bulk Plants

65,785 miles 5.6%
4,356 man hours 1.5% @ 2400 hours=2 men

While many of the marketers have zoned their deliveries around bulk plants, 6 of the larger suppliers, as stated above, operate over the entire area from single plants. Therefore, zoning shows a substantial reduction in mileage over that calculated for joint use of bulk plants.

Estimated Reductions by Zoning

380,350 miles 31.5%
25,357 man hours 8.5% @ 2400 hours=10 men

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Metropolitan Milwaukee

The supply comes from 2 terminals located close together near the center of distribution, and from the Chicago area refineries. The supply transport miles represent a large part of the total miles. Cross-hauling of transport movements is no factor, as nearly all of the bulk plants are north of the terminals and hence most movements come from a southerly direction.

40% of the volume is delivered direct from the terminals. The many relatively small marketing trucks, plus the congestion at the local terminals, makes it desirable from a mileage viewpoint to transport the balance to the bulk plants for re-delivery.

The bulk plants are scattered through several sections, but some large areas have no plants. Many of the marketers have only 1 bulk plant and deliver into rather wide areas. This condition indicates some savings in marketing truck mileage can be accomplished by joint-use of bulk plants.

Estimated Reductions by Joint-Use of Bulk Plants

95,878 miles 8.1%
3,321 man hours 1.8% @ 2400 hours=1 man

Because of the large areas into which deliveries are made by many of the marketers, the zoning of accounts shows substantial reductions in truck mileage beyond those calculated for the joint-use of bulk plants.

Estimated Reductions by Zoning

271,061 miles 22.9%
8,302 man hours 4.5% @ 2400 hours=3 men

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Metropolitan Kansas City

Most of the supply comes from 5 terminals, 3 of which are in the northwest section of the city, 1 in the central western section, and 1 in the northeast section. This situation brings about some cross-hauling of transport movements. However, since the terminals are right in the city, the transport miles are low.

57% of the volume is delivered direct. The bulk of the domestic heating oil market lies south of the terminals and, therefore, cross-hauling on truck deliveries is insignificant.

Most of the bulk plants are in the northwest section of the city, where their supply originates and marketing truck movements are in the same general direction, which makes for a minimum of cross-hauling of back-hauling. Some reduction in mileage is indicated by the joint-use of bulk plants.

Estimated Reductions by Joint-Use of Bulk Plants

32,654 miles 6.1%
3,341 man hours 3.5% @ 2400 hours=1 man

Many of the suppliers have restricted the delivery areas from their bulk plants in respect to small deliveries, and in addition, 57% of the total volume is delivered direct from the terminals. The zoning of accounts would, therefore, bring about an infinitesimal further reduction in miles, or none at all, and probably would require added man hours.

Estimated Reductions by Zoning

32,654 miles 6.1%
3,341 man hours 3.5% @ 2400 hours=1 man

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Metropolitan Cleveland

The supply comes principally from 2 terminals located in the center of the market. There is no cross-hauling of transport movements.

79% of the volume is delivered direct from the terminals, leaving a relatively small percentage subject to possible reductions through the joint-use of bulk plants.

There are 15 non-terminal bulk plants in the area, and the 3 largest marketers have more than 1 plant. The outlying bulk plant areas are restricted to the volume immediately surrounding these plants. Quite a few of the marketers have been participating in joint-use of terminals and bulk plants. These conditions limit the reductions possible by further joint-use of bulk plants.

Estimated Reductions by Joint-Use of Bulk Plants

14,800 miles 4.3%
850 man hours 1.5% @ 2400 hours=0 men

The domestic heating oil accounts are concentrated, to a large degree in particular areas in the city. Because of this concentration of customers and the small number of marketers operating throughout the entire metropolitan area, the indicated reductions from zoning are small.

Estimated Reductions by Zoning

27,600 miles 8.0%
1,470 man hours 2.5% @ 2400 hours=1 man

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City of Madison (Pilot Survey)

The supply comes from points a considerable distance from Madison, resulting in relatively high transport miles to marketing truck mil:s. There is no cross-hauling of transport movements.

There are 22 non-terminal bulk plants in the city, 10 of which are clustered in the central part of the city and 12 scattered in the outlying districts. There is no concentration of accounts in any given area, and the individual bulk plant areas are quite large. As a result, there is cross-hauling, some of which could be eliminated by the joint-use of bulk plants.

Estimated Reductions by Joint-Use of Bulk Plants

33,651 miles 6.7%
1,723 man hours 3.1% @ 2400 hours=1 man

Because of the large bulk plant areas, a further reduction could be made by zoning, over that calculated from the joint-use of bulk plants.

Estimated Reductions by Zoning

52,737 miles 10.5%
2,723 man hours 4.9% @ 2400 hours=1 man

Name Manpower Advisors

NPN News Bureau

NEW YORK—W. C. Burns, chairman of the manpower subcommittee of the marketing committee for District 1 has announced the list of state chairmen for the subcommittee. The list comprises:

Maine—R. H. Tyler, American Oil Co., Portland; **New Hampshire**—L. L. Langmaid, Gulf Oil Co., Manchester; **Vermont**—H. W. Ryder, Shell Oil Co., Albany, N. Y.; **Rhode Island**—J. J. Gill, Petroleum Heat & Power Co., Providence; **Connecticut**—C. N. Mitchell, Colonial Beacon Oil Co., Hartford; **Massachusetts**—C. A. Sheehan, Socony-Vacuum Oil Corp., Cambridge; **New York**—H. H. Willetts, Socony-Vacuum Oil Corp., New York City; **New Jersey**—E. T. Lemmon, Standard Oil Co. of N. J., Elizabeth; **Pennsylvania** and **Delaware**—J. A. Corey, Atlantic Refining Co., Philadelphia; **Maryland** and **District of Columbia**—J. R. Sherwood, Baltimore; **Virginia**—W. T. Hyde, Gulf Oil Co., Richmond; **West Virginia**—J. C. King, Standard Oil Co. of N. J., Charleston; **South Carolina**—L. L. Trego, Sinclair Refining Co., Columbia; **North Carolina**—T. A. Aldridge, American Oil Co., Charlotte; **Georgia**—T. F. Horton, The Texas Co., Atlanta; **Florida**—J. F. Early, Standard Oil Co. of Kentucky, Jacksonville.

Metropolitan Area Domestic Heating Oil Surveys

Annual Figures Based On Survey of January, February and March 1943 Conditions

	Chicago	Minn.-St. Paul	St. Louis	Milwaukee	Kansas City	Cleveland	(Pilot Survey) Madison
1942-3 Season Volume—as reported—gals.	126,615,499	96,202,996	46,000,000	33,640,000	25,962,694	10,000,000	10,251,634
Number Marketers Reporting	97	61	34	26	18	11	22
Number Refineries & Terminals	7	7	4	2	4	2	0
Number Non-Terminal Bulk Plants	148	45	37	27	14	15	22
Total Number of Plants	155	52	41	29	18	17	22
Number Marketers Not Reporting	59	0	7	2	3	0	1
Percent Reporting	90%	100%	95%	97%	98%	100%	99%
Weighted Average Truck Size	1,286	1,180	1,073	1,150	1,470	1,164	1,000
Total Transport Truck Miles	1,488,504	69,361	32,600	572,037	67,864	23,000	359,872
Total Marketing Truck Miles	1,099,282	1,685,904	1,175,100	611,636	467,449	324,000	142,384
Total Miles	2,587,786	1,755,265	1,207,700	1,183,673	535,313	347,000	502,256
Total Drivers Hours	568,885	482,514	297,102	184,489	95,451	58,400	55,573
Joint Use:—Miles	2,361,873	1,202,938	1,141,915	1,087,795	502,659	332,200	568,605
Est. Reduction	225,913	482,966	65,785	95,878	32,654	14,800	33,651
% Reduction	8.7%	27.5%	5.5%	8.1%	6.1%	4.3%	6.7%
Hours	546,826	249,164	292,746	181,168	92,110	57,550	53,850
Est. Reduction	22,059	33,350	4,356	3,321	3,341	850	1,723
% Reduction	3.9%	6.9%	1.5%	1.8%	3.5%	1.5%	3.1%
Zonings:—Miles	2,361,873	955,446	827,350	912,612	502,659	319,400	449,519
Est. Reduction	225,913	730,458	380,350	271,061	32,654	27,600	52,737
% Reduction	8.7%	41.7%	31.5%	22.9%	6.1%	8.0%	10.5%
Hours	546,826	432,658	271,745	176,187	92,110	156,930	52,850
Est. Reduction	22,059	49,856	25,357	8,302	3,341	1,470	2,723
% Reduction	3.9%	10.3%	8.5%	4.5%	3.5%	2.5%	4.9%
% Heating Oil Delivered Direct	2.6%	0	0	40%	57%	79%	0
% Present Joint Use	0	0	0	0	Little	16	0

WAR OIL ORDERS

(*Continued from p. 14*)

ing miscellaneous chemicals, bottles, jars, packing glasses, cans, liquids, pastes, and semi-liquids, naval stores, pine pitch and tar, rosin, rosin dross, pinene, pine oil, pine tar oil; rosin liquor and rosin oil, paste, pitch, or sizing; turpentine, crude wood oil, dry rosin size, and roofing materials. Issued 10-23, effective 11-1.

General Permit ODT 18A-1—Carload freight shipments—In conformity with regulations of GO ODT 18A, permit is issued to allow loading of certain commodities in weights other than those heretofore permitted. Textile bags of all fibers, old or new, in machine-compressed bales may be loaded to not less than 45,000 lbs. weight, empty return-movement gas cylinders to not less than 36,000 lbs. Issued 10-23, effective 11-1.

Special Direction ODT 18A-3—Rail carriers may accept from a water carrier carload freight, loaded initially on freight car in accordance with ODT 18A, or by general or special permit, and transfer to a car of larger capacity for last rail journey, if loaded as heavily as initial freight car. Restriction against two cars smaller than initial carrier, if water carrier ordered proper size, does not apply. Closed cars loaded from water carrier must be loaded to 80,000 lbs. net or to marked capacity, if less, or so as to use minimum of 2500 cu. ft. Open cars must be loaded to 100,000 lbs. net, marked capacity, if less, or use 1,500 cu. ft. minimum. Not applicable to carload freight first moved on high seas, and thence by rail. Issued 10-23, effective 11-1.

Department of Labor

MINIMUM WAGE HEARING — Dept. of Labor, Wage & Hour Div., will hold public hearing on 11-18-43 in New York as to approval or disapproval of Industry Committee 66's recommendation of wage rate not under 40c to employes in metal ore, coal, petroleum, and natural gas extraction Industries. Interested persons wishing to appear in support of or opposition to the measure must file with Administrator by 11-15 notice of intent to appear. Stenographic transcript of proceedings will be available and complete record will be on file with Administrator. Issued 10-13.

Treasury Department

COMMISSION PAYMENTS UNDER T. D. 5295—Treasury Department press release states Commissioner of Interior Revenue grants employers permission to pay commissions due employes for September and October in all cases in which neither the rate of commission nor amount of any other compensation has been increased since 10-2-42. After 9-4-43 approval required for payment of amounts exceeding amount paid each employe for last accounting period ended prior to 10-3-42 on all salaries under Commissioner's jurisdiction (over $5000, or lesser salaries paid to executive, administrative, or professional employe). Applications to be filed with employer's regional office. Issued 10-7

Department of Interior

U. S. LAND LEASES—Circular 1565, Gen. Land Office, Dept. of Interior—Competitive bidding sealed, or at public auction, permitted for lease in 640 acre-units, of unappropriated lands and deposits subject to disposition under Act of 2-25-20, as amended. Lands within known geologic structures of producing oil and gas fields subject to leasing only by competitive bidding, and filing of applications is of no avail. Approved 10-25.

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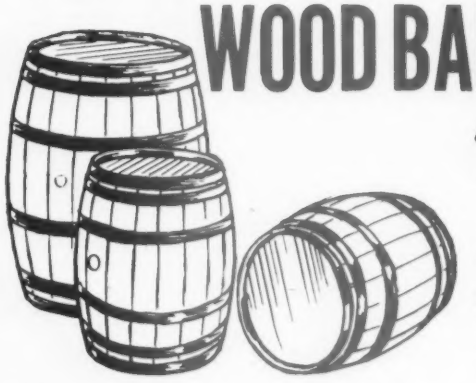

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Oil Industry of Texas Is Watching Fight On State's Labor Act

Special to NPN

AUSTIN, Tex.—Texas' oil industry is watching with more than passing interest the attacks of organized labor on Texas' Manford Act.

The act, passed by the last session of the state legislature, requires that all labor organizers take out a permit from the secretary of state; requires unions to file annual financial statements; regulates time and manner of holding union elections; prohibits unions from contributing to political campaigns, and limits fees to those "reasonably" required to operate the union.

Friends of the bill won a major point Oct. 27 when the Texas Supreme Court ruled that the section requiring labor organizers to register is valid. The case came up when R. J. Thomas, president of the C. I. O.'s United Automobile Workers union, made a speech in Pelly, Texas, in which he singled out a man in the audience and asked him to join the C. I. O. oil field workers' union.

Before the speech, Thomas had publicly stated that one of the purposes of his trip to Texas was to test the Manford Act.

The state obtained an injunction forbidding Thomas to violate the law, and when he ignored the injunction District Judge J. Harris Gardner of Austin had him cited for contempt of court and sentenced him to 3 days in jail and a $100 fine.

Lounges in Jail Lobby

The Detroit union leader lolled around in the jail's outer office for several hours before being released on appeal. The Texas Supreme Court ruled that this section of the Manford Act is valid and Thomas must serve the jail sentence.

Thomas announced from Washington that he would appeal to the U. S. supreme court. Thomas was given 15 days in which to file a motion for rehearing and 30 days to appeal to a higher court.

In the meantime, in another Austin district court, union leaders from all over the nation are seeking a double-barreled judgment against the Manford Act. They are asking District Judge J. D. Moore for a declaratory judgment that the act is invalid, and also for an injunction against its enforcement. At week's end Judge Moore granted a request of attorneys on both sides for time to file additional briefs. A month's delay before any decision is reached is expected.

In the Supreme Court's decision on the Thomas case, Chief Justice James Alexander wrote that "the state, under its police power, may enact laws which interfere directly or indirectly and to a limited extent with the right of speech, or the liberty of the people, where they are reasonably necessary for the protection of the general public."

Coming Meetings

NOVEMBER

American Petroleum Institute, annual meeting, Palmer House, Chicago, Ill., Mon.-Thurs., Nov. 8-11.

Petroleum Equipment Suppliers' Assn., annual meeting, Palmer House, Chicago, Ill., Tues., Nov. 9.

American Institute of Chemical Engineers, annual meeting, William Penn Hotel, Pittsburgh, Pa., Mon-Tues., Nov. 15-16.

South Dakota Independent Oil Men's Assn., annual convention, Marvin Hughitt Hotel, Huron, S. D., Mon.-Tues., Nov. 29-30.

Mid-Continent Oil and Gas Assn., 25th annual membership meeting and annual meeting of executive committee, Tulsa Club Roof, Tulsa, Okla., Tues., Nov. 30.

American Society of Mechanical Engineers, annual meeting, Hotel Pennsylvania, New York, N. Y., Mon.-Fri., Nov. 29-Dec. 3.

DECEMBER

New Mexico Oil and Gas Assn., annual meeting, Carper Terrace, Artesia, N. M., Wed., Dec. 1.

19th Exposition of Chemical Industries, Madison Square Garden, New York, N. Y., Mon.-Sat., Dec. 6-11.

Nebraska Petroleum Marketers, Inc., annual meeting, Fontenelle Hotel, Omaha, Nebr., Tues.-Thurs., Dec. 7-9.

National Assn. of Manufacturers, annual meeting, Waldorf-Astoria, New York, N. Y., Wed.-Fri., Dec. 8-10.

New Jersey Oil Trades Assn., annual banquet, Robert Treat Hotel, Newark, N. J., Thurs., Dec. 9.

Mid-Continent Oil and Gas Assn., 26th annual meeting of general board of directors, Tulsa Club Roof, Tulsa, Okla., Mon., Dec. 13.

Wisconsin Petroleum Assn., annual convention, Milwaukee, Wis., Wed.-Thurs., Dec. 15-16.

Detroit Fuel Oil Distributors' Assn., annual meeting, Detroit Oil Men's Club, Leland Hotel, Detroit, Mich., Tues., Dec. 21.

Geological Society of America, annual business meeting, New York, N. Y., Tues., Dec. 28.

San Joaquin Valley Oil Producers Assn., Hotel El Tejon, Bakersfield, Calif., Wed., Dec. 29.

JANUARY

Society of Automotive Engineers, annual meeting and engineering display, Book-Cadillac Hotel, Detroit, Mich., Mon.-Fri., Jan. 10-14.

North Carolina Oil Jobbers' Assn., annual meeting, Hotel Carolina, Raleigh, N. C., Wed., Jan. 12.

Northwest Petroleum Assn., annual meeting, Nicollet Hotel, Minneapolis, Minn., Thurs.-Fri., Jan. 13-14.

FEBRUARY

American Institute of Mining and Metallurgical Engineers, annual meeting, Waldorf-Astoria, New York, N. Y., Sun.-Thurs., Feb. 20-24.

Iowa Independent Oil Jobbers' Assn., annual meeting, Hotel Fort Des Moines, Des Moines, Ia., Wed.-Thurs., Feb. 23-24.

Service Executives to Rally

Special to NPN

KANSAS CITY, Mo.—Tire, Battery and Accessory Executive Group conference to be held at Elms Hotel, Excelsior Springs, Mo., Dec. 2 and 3, will be open to all oil company executives, Chairman Charles A. Johnson of the Ohio Oil Co. of Findlay, O., has announced.

Postwar service stations, declared potentially the nation's greatest retail distribution system, will be discussed. Program speakers include Paul Hoffman, president, The Studebaker Corp.; D. W. Mackenroth, manager of retail stores for Goodyear Tire & Rubber Co.; Raymond Shaw, president, Chek-Chart Corp., and Herbert King, vice president in charge of sales for National Battery Co.

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PLATT'S WAR-OIL DIRECTORY CONTENTS

(Partial List)

Correct names, initials, titles, addresses, room numbers, telephone numbers and extensions, of individuals active for the oil industry in the following War-Oil groups:

Government War-Oil Agencies
(Official and Semi-Official)

PETROLEUM ADMINISTRATION FOR WAR
PETROLEUM INDUSTRY COMMITTEES
OFFICE OF DEFENSE TRANSPORTATION
OFFICE OF PRICE ADMINISTRATION
PETROLEUM INDUSTRY WAR COUNCIL
OFFICE OF RUBBER DIRECTOR
RUBBER RESERVE COMPANY
WAR PRODUCTION BOARD

Other Government War Agencies

ARMY and NAVY PETROLEUM BOARD
DEFENSE PLANT CORPORATION
DEFENSE SUPPLIES CORPORATION
NATIONAL WAR LABOR BOARD
OFFICE OF ECONOMIC STABILIZATION
RECONSTRUCTION FINANCE CORPORATION
WAR EMERGENCY PIPELINES INC.
WAR MANPOWER COMMISSION
WAR SHIPPING ADMINISTRATION

Government Departments

CAPITOL and CONGRESS
INTERIOR
NAVY
UNITED STATES MARITIME COMMISSION
WAR

Miscellaneous

AMERICAN PETROLEUM INDUSTRIES COMMITTEE
INTERSTATE OIL COMPACT COMMISSION REPRESENTATIVES
MEMBERS NATIONAL CONFERENCE PETROLEUM REGULATORY AUTHORITIES
OIL COMPANY REPRESENTATIVES IN WASHINGTON
OIL ASSOCIATIONS IN UNITED STATES

Plus

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WAR-OIL COMMUNICATION SERVICES

REFINERY WORKERS, FLIERS FETED

(*Continued from p. 1*)

real planning on the part of the company management.

When Mr. Ashton learned of the visit of the fliers his first thought was for their reception. Out of consideration for them, the program was arranged to allow them as much leisure time as possible during their visit. Aside from being greeted upon their arrival in the morning, the ceremonies during the noon hour, and a luncheon at 7 o'clock at night, the fliers were given the day for relaxation and rest.

Heralding the arrival of the crew, Socony-Vacuum used dominent newspaper space, playing up with equal space the refinery workers and the intrepid crew of "Old Hell Cat". The advertisement carried a heading reading

WORKERS
and
WARRIORS

Socony-Vacuum *Salutes You All!*

Our Hats Off To the Intrepid Crew of "Old Hell Cat" and To The Tireless East St. Louis Workers Who Helped To Keep Her Flying and Fighting for Our Country!

Half of the body type was devoted to a tribute to the heroes and half to the East St. Louis refinery workers. Aside from the company trade mark, and an announcement that the new TCC refining process was s on to be producing aviation gasoline from East St. Louis there was no commercialism in the advertisement. Another large advertising spread in an East St. Louis paper along the same lines was signed jointly by labor unions and the Socony-Vacuum Oil Co., Inc., Lubrite Division.

Crew Greeted on Arrival

Upon the arrival of the crew, they were greeted by Mr. Ashton, the Mayor of East St. Louis, and 48 refinery men, including officials and business agents of all crafts and unions operating either in a construction or manufacturing capacity at the East St. Louis refinery. They were taken to the refinery where workers and construction crews were introduced.

As the grimy workers, rubbing elbows with office executives, superintendents and stillmen, heard Mr. Ashton and the bombardiers, tail gunners and high war department officials tell them that their lives and those of thousands of others in combat depend on the support of refinery workers in supplying unfailing and abundant flow of 100 octane gasoline, chests expanded from the lowest bull pen laborer to the highest paid technician.

As the workers went back to their jobs as proud as a victorious army division, "Ash" Ashton had chalked up another management success. He had welded labor and management on the home front with the soldiers on the front line from what otherwise would have been another "war rally".

AUTHENTIC COPIES of Official OPA Price Ceilings

The issue of **NATIONAL PETROLEUM NEWS** of October 8, 1941 has been designated by the Office of Price Administration as the *only* publication carrying the official price ceilings on bulk petroleum products, except where special circumstances prevail.

The price section of this issue has been reproduced in replica by **NATIONAL PETROLEUM NEWS** for general use by the industry.

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NATIONAL PETROLEUM NEWS
1213 West 3rd Street
Cleveland 13, Ohio

Demand Simpler Procedure on Sales to U. S.

NPN News Bureau

LOS ANGELES—An appeal has been made by the District 5 marketing committee to Walter Hochuli, PAW director of marketing, to help stop the waste of manpower hours and tons of paper in connection with the securing of Federal Exemption Certificates required in the sale of taxable petroleum products to federal agencies.

The District 5 marketing committee acted after complaint had been received from L. S. Parker, controller, Gilmore Oil Co., concerning the difficulties encountered by his company.

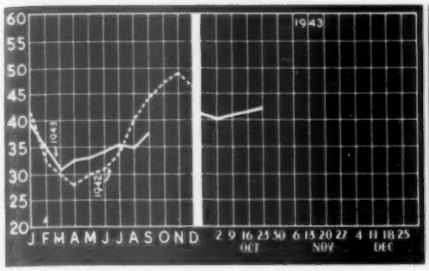
C. W. Coughlin, assistant to the comptroller, Richfield Oil Corp., in a communication to Richfield's vice-president, W. T. Dinkins, revealed that he has been in contact with the Bureau of Internal Revenue and the procurement division of the Treasury Department for the past 18 months in attempts to secure simplification of the procedure.

Mr. Coughlin suggests that Congress revoke the present provision of the Internal Revenue Code which grants exemptions from federal excise taxes on sales of taxable articles to the federal government. If that is done, he points out, the various federal purchasing agencies will pay the federal taxes to the supplying contractor and these same taxes will be paid back into the U. S. treasury by the original manufacturer, supplier or retailer.

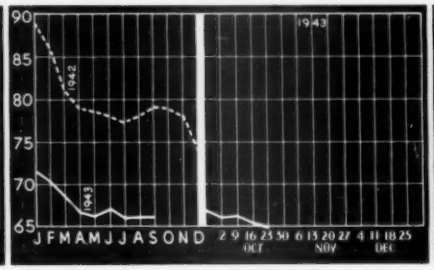
It was also suggested by Mr. Coughlin that a system used by the State of California in checking exemptions claimed from California taxes on sales to departments, agencies and instrumentalities of the federal government be provided. On such sales, California does not concern itself with the great multiplicity of exemption certificates on the appropriate federal form; rather, reference is made to the written contract, to the record of receipt of payment by U. S. Treasury check, that the sales were, in fact, sales to the federal government and entitled to exemption accordingly.

The Treasury Department and the Bureau of the Budget, Mr. Coughlin revealed, are in favor of eliminating the statutory exemptions but there is opposition from the War Department and the Navy Department.

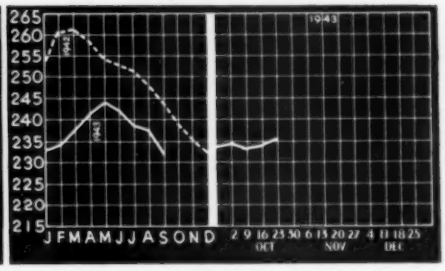
Gas Oil and Distillate Stocks



Residual Fuel Oil Stocks



Crude Stocks



Refinery Operations

(American Petroleum Institute figures in thousands of barrels of 42 gal. each. Figures include reported totals plus estimate of unreported amounts and are therefore on a Bureau of Mines basis.)

Districts	Daily Potential Refining Capacity Week Ended Oct. 23	Daily Potential Refining Capacity Week Ended Oct. 16	Per Cent of Refining Capacity Reporting Week Ended Oct. 23	Per Cent of Refining Capacity Reporting Week Ended Oct. 16	Daily Average Crude Runs to Stills Week Ended Oct. 23	Daily Average Crude Runs to Stills Week Ended Oct. 16	Per Cent of Reporting Capacity Operated Week Ended Oct. 23	Per Cent of Reporting Capacity Operated Week Ended Oct. 16
Combined**	2,444	2,444	88.7	88.7	2,092	2,079	85.6	85.1
Appalachian (Dist. No. 1)	130	130	83.9	83.9	93	91	71.5	70.0
Appalachian (Dist. No. 2)	47	47	87.2	87.2	44	40	93.6	85.1
Ind., Ill., Ky.	824	824	85.2	85.2	764	747	92.7	90.7
Okla., Kans., Mo.	416	416	80.1	80.1	350	358	84.1	86.1
Rocky Mt. (Dist. No. 3)	8	8	26.9	26.9	8	8	100.0	100.0
Rocky Mt. (Dist. No. 4)	141	141	58.3	58.3	90	91	63.8	64.5
California	817	817	89.9	89.9	719	757	88.0	92.7
Total U. S.—B. of M. Basis	4,827	4,827	86.4	86.4	4,160	4,171	86.2	86.4
U. S.—B. of M. Basis Oct. 24, 1942					3,775			

Districts	Gasoline Production at Refineries Inc. Natural Blended Week Ended Oct. 23	Gasoline Production at Refineries Inc. Natural Blended Week Ended Oct. 16	Stocks of Finished and Unfinished Gasoline Week Ended Oct. 23	Stocks of Finished and Unfinished Gasoline Week Ended Oct. 16	Total Stocks Gas Oil & Distillates Week Ended Oct. 23	Total Stocks Gas Oil & Distillates Week Ended Oct. 16	Total Stocks Residual Fuel Oil Week Ended Oct. 23	Total Stocks Residual Fuel Oil Week Ended Oct. 16
Combined**	6,093	5,868	30,690	30,198	21,102	20,314	18,625	18,672
Appalachian (Dist. No. 1)	296	279	1,528	1,532	813	931	243	250
Appalachian (Dist. No. 2)	152	124	662	512	107	94	156	153
Ind., Ill., Ky.	2,672	2,548	13,405	13,622	6,424	6,106	3,223	3,291
Okla., Kans., Mo.	1,265	1,213	6,274	6,148	2,401	2,462	1,374	1,465
Rocky Mt. (Dist. No. 3)	30	32	66	67	26	25	33	31
Rocky Mt. (Dist. No. 4)	288	303	1,021	1,070	407	405	694	692
California	1,858	1,991	15,150	15,033	12,029	11,900	40,399	40,964
Total U. S.—B. of M. Basis	12,654	12,358	68,796*	68,182	43,309	42,237	64,747	65,518
U. S.—B. of M. Basis Oct. 24, 1942	11,481	.....	77,057	.....	48,102	.....	79,142	.....

*Finished 58,854,000 bbl.; Unfinished 9,942,000 bbl.

**Includes East Coast, Inland Texas, Texas Gulf, Louisiana Gulf, and North Louisiana-Arkansas districts. Dist. 1 Inventory Indices are: Gasoline 34.9%, Kerosine 51.6%, Gas, Oil & Distillate Fuel, 53.1% and Residual Fuel Oil 81.1% of Normal.

Crude Oil Stocks

(Bureau of Mines Figures in thousands of bbls.)

Grade or Origin	Oct. 23	Oct. 16	Change from Oct. 16
Penna. Grade	2,521	2,563	— 42
Other Appalachian	1,393	1,371	+ 22
Lima-Michigan	1,030	1,075	— 45
Illinois-Indiana	11,668	11,588	+ 80
Arkansas	2,892	2,827	+ 65
Kansas	8,109	8,082	+ 27
Louisiana:	13,869	13,769	+100
Northern	4,557	4,466	+ 91
Gulf Coast	9,312	9,303	+ 9
Mississippi	1,226	1,168	+ 58
New Mexico	7,831	7,853	— 22
Oklahoma	34,782	34,826	— 44
Texas:	104,622	103,071	+1,551
East Texas	22,411	22,219	+192
West Texas	23,961	23,368	+593
Gulf Texas	31,995	31,135	+860
Other Texas	26,255	26,349	— 94
Panhandle	6,706	6,636	+ 70
North	5,461	5,709	—248
South	4,951	4,871	+ 80
Other	9,137	9,133	+ 4
Rocky Mountain	12,301	12,371	— 70
California	32,814	32,545	+269
Foreign	940	888	+ 52
Tot. gasoline-bearing in U. S.	235,998	233,997	+2,001
Heavy in California	8,576	8,537	39

U. S. Crude Oil Production

(American Petroleum Institute figures in Bbls.)

	WEEK ENDED Oct. 23 Barrels (Daily Average)	Oct. 16 Barrels (Daily Average)
Oklahoma	326,500	326,450
Kansas	284,750	296,950
Nebraska	1,700	1,750
Texas	1,891,900	1,891,900
Louisiana	359,950	360,050
Arkansas	78,450	78,350
Mississippi	47,200	46,400
Illinois	223,750	209,750
Indiana	13,350	13,900
Eastern (Ill., Ind. & Ky. excluded)	73,200	74,950
Kentucky	24,150	22,950
Michigan	54,400	55,100
Wyoming	104,050	106,250
Montana	21,350	21,350
Colorado	7,200	7,300
New Mexico	112,550	109,350
California	785,300	789,200
Total United States	4,409,750	4,411,950

Pennsylvania Crude Runs

(Compiled by National Petroleum Assn. from reports of all companies refining Pennsylvania crude. Figures in bbls.)

Week ended	Daily Average	Week ended	Daily Average
Feb. 6	67,494	June 26	69,551
Feb. 13	69,103	July 3	68,542
Feb. 20	78,797	July 10	75,188
Feb. 27	77,285	July 17	73,156
Mar. 6	70,389	July 24	62,047
Mar. 13	73,184	July 31	64,011
Mar. 20	77,828	Aug. 7	57,594
Mar. 27	82,224	Aug. 14	67,191
Apr. 3	81,093	Aug. 21	79,917
Apr. 10	74,317	Aug. 28	78,000
Apr. 17	70,445	Sept. 4	72,236
Apr. 24	76,625	Sept. 11	72,743
May 1	76,555	Sept. 18	75,420
May 8	77,088	Sept. 25	82,851
May 15	79,366	Oct. 2	72,485
May 22	76,064	Oct. 9	66,904
May 29	76,488	Oct. 16	69,008
June 5	71,505	Oct. 23	76,517
June 12	76,766	1942 Low	67,243
June 19	68,115	1942 High	87,251

N.P.N. Gasoline Index

	Dealer T.W. Cents	Tank Car Per Gal.
Nov. 1	10.45	6.92
Month ago	10.43	6.92
Year ago	10.47	6.50

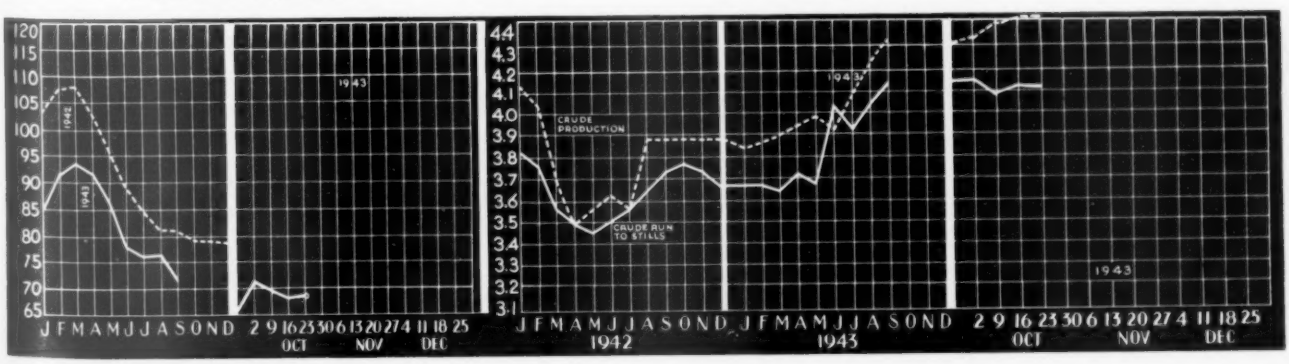
Dealer index is an average of "undivided" dealer prices, ex-tax, in 50 cities.

Tank car index is weighted average of following wholesale markets for regular-grade gasoline, FOB refineries or terminals: Okla., Mid-Western, W. Penna., Calif., N. Y. Harbor, Philadelphia, Jacksonville, Boston and Gulf Coast.

Gasoline Stocks

(Finished and Unfinished)

Crude Production and Runs to Stills



Market Reports

GULF COAST—refined products market continues tight. Although bunker C Fuel reported the product most easily available, one refiner withdrew his quotation of $1.09-1.27 for lack of material. Gasoline, min. 80-oct. (A.S.T.M.), was quoted at flat price of 6.75c in tank cars when one refiner in New Orleans raised his quotation 0.25c. No other changes were reported.

° ° °

ATLANTIC COAST—Substantial increase in available supplies of 16-19.9 gravity bunker "C" in New York harbor resulted in one more supplier lowering his price 12c on this product, quoting $1.77 bbl. Light fuel stocks were generally reported "in fair shape" and one supplier in Philadelphia reentered the market quoting ceiling price of 6.7c on No. 2 fuel. No other changes reported.

° ° °

PENNSYLVANIA—Neutrals displayed greater firmness as several Western Penna. refiners hiked their quotations to 30c for 200 vis. 25 p.t. and to 28c for 150 vis. 25 p.t. Refiner reported sale of 2 cars of 200 vis. neutral at 28.5c and raised his quotation 1c to 26.5c for 150 vis. Lows remained unchanged. New price ranges for these products are 27-30c and 25-28c, respectively.

Lower field refiner re-entered market with quotations of 7.75c for Stoddard solvent and 7.25c for 46 w.w. kerosine. Price ranges were unaffected. No other price changes reported.

° ° °

MID-WEST—Reports of overflow of industrial fuel oils circulated throughout mid-western market last week since eastern buyers are no longer taking much of the materials and storages in this area are filled to overflowing. Domestic fuels, however, continue in strong demand with most refiners and marketers still trying to get material with which to fill storages.

Gasoline demand has shown no change. Refiners still trying to supplement their own production with inter-refinery purchases having little luck. One marketer in this area withdrew Group 3 quotas on Ethyl and housebrand gasoline because of difficulty getting any out of the Southwest. No price changes among refiners.

° ° °

MID-CONTINENT—Agricultural demand for gasoline was reported slightly eased by several mid-continent refiners this week. Decrease was not sufficient to enable them build any storage, they said. Demand for burning oils continues to increase with supplies limited. Despite rumor that heavy fuel oil is becoming more easily available majority of refiners say railroads are taking residual as fast as they can make it. Price ranges on all refined products unchanged.

Twenty-three cars Grade 26-70 natural gasoline were reported sold at 4.75c f.o.b. Group 3, and 19 cars were reported sold at 4.375c, f.o.b. Breckenridge.

° ° °

CALIFORNIA — Recent OPA rulings, which allow refiners higher prices for tank truck deliveries than for F.O.B. refinery sales, have just about dried up the spot refinery market in California. Some refiners will still quote prices, bottom of the range being 6.5 and 7.5 for regular and Ethyl, but most deals are being made on a delivered price which is about 1 cent higher.

Fuel oil is firming again. One company called for bids on 75,000 barrels of heavy fuel but only got bids totaling 60,000 barrels. Lowest price was $1.05 or 5c under ceiling. On smaller sales ceiling price of $1.10 seems to prevail.

CRUDE PRICES

Since changes in crude oil prices are so few, the 2 pages of crude oil price tables hereafter will be printed only when there are sufficient changes in prices to warrant.

In the meantime a record is being kept in the Cleveland office of NPN and OILGRAM from which the publishers will be glad to make proofs, or letters or affidavits as to what the prices are, and without charge to regular subscribers. Changes in crude oil prices will be specially noted in this market section when made.

Crude Price Changes

(No changes reported during week ended Nov. 3. For latest tables of crude prices see NPN Oct. 27, pages 51, 52.)

Adams Sells Oil Pools Share

Special to NPN

HOUSTON — A deal transferring Adams Oil and Gas Co.'s one-quarter interest in the Oyster Bayou, Will Slough and Seabreeze oil pools, Chambers County, Tex., to the Pan American Production Co., has been closed. The title transfer was dated Sept. 1.

Total consideration involved was $9,500,000 in cash and notes.

The one-quarter interest totals between 1800 and 2000 bbls. of oil daily. The other three-quarters interest is owned by the Sun Oil Co., operator of the properties.

Summary of Daily Gasoline Prices (October 25 to November 1)

	Monday Nov. 1	Friday Oct. 29	Thursday Oct. 28	Wednesday Oct. 27	Tuesday Oct. 26
U. S. Motor (ASTM octane)					
78 octane Ethyl:					
Oklahoma	6.75 - 6.875	6.75 - 6.875	6.75 - 6.875	6.75 - 6.875	6.75-7.25
Mid-Western (Group 3 basis)	6.75 - 7.25	6.75 - 7.25	6.75 - 7.25	6.75 - 7.25	7
N. Tex. (For shpt. to Tex. & N. M. dest'ns.)	7	7	7	7	7
W. Tex. (For shpt. to Tex. & N. M. dest'ns.)	7 (2)	7 (2)	7 (2)	7 (2)	7 (2)
72-74 octane:					
Oklahoma	6	6	6	6	6
Mid-Western (Group 3 basis)	6	6	6	6	6
N. Tex. (For shpt. to Tex. & N. M. dest'ns.)	6	6	6	6	6
W. Tex. (For shpt. to Tex. & N. M. dest'ns.)	6	6	6	6	6
63-66 octane:					
Oklahoma	5.625 (2)	5.5 - 5.625	5.625 (2)	5.625 (2)	5.625 (2)
Mid-Western (Group 3 basis)	5.6 - 5.625	5.5 - 5.625	5.5 - 5.625	5.5 - 5.625	5.5 - 5.625
N. Tex. (For shpt. to Tex. & N. M. dest'ns.)	5.625 (2)	5.625 (2)	5.625 (2)	5.625 (2)	5.625 (2)
W. Tex. (For shpt. to Tex. & N. M. dest'ns.)	5.75 (1)	5.75 (1)	5.75 (1)	5.75 (1)	5.75 (1)
60 octane & above:					
Oklahoma	5.25	5.125- 5.25	5.25	5.25	5.25
Mid-Western (Group 3 basis)	5.2 - 5.25	5.2 - 5.25	5.2 - 5.25	5.2 - 5.25	5.2 - 5.25
N. Tex. (For shpt. to Tex. & N. M. dest'ns.)	5.2 - 5.25	5.2 - 5.25	5.2 - 5.25	5.2 - 5.25	5.125- 5.25
W. Tex. (For shpt. to Tex. & N. M. dest'ns.)	5.25	5.25	5.25	5.25	5.25
Motor Gasoline, 72-74 octane (ASTM)					
New York harbor	9.2 - 9.4	9.2 - 9.4	9.2 - 9.4	9.2 - 9.4	9.2 - 9.4
New York harbor, barges	9.1 - 9.3	9.1 - 9.3	9.1 - 9.3	9.1 - 9.3	9.1 - 9.3
Philadelphia district	9.2	9.2 - 9.7	9.2 - 9.7	9.2 - 9.7	9.2 - 9.7
Baltimore district	8.95	8.95	8.95	8.95	8.95
Motor Gasoline:					
Western Penna. Bradford-Warren:					
"Q" Gasoline, Min. 70 Oct. (ASTM)	7.5 - 8.95	7.5 -7.75 (2)	7.5 - 8.95	7.5 - 8.95	7.5 - 8.95
Western Penna. Other Districts:					
"Q" Gasoline, Min. 70 Oct. (ASTM)	7.5 - 7.75	7.5 - 7.75	7.5 - 7.75	7.5 - 7.75	7.5 - 7.75

OIL PRICE SECTION ★ At Refineries and Terminals and by Tank Wagon

Prices herewith are reproduced from Platt's *OILGRAM* Daily Oil Price Service, associated with National Petroleum News, whose representatives in all *NPN-OILGRAM* offices devote their time exclusively to reporting oil industry prices everywhere.

Prices shown are actual sales prices, or quotations meaning sellers' general offers or posted prices; for current sales and shipment; for the business day or period stated; except Tank Wagon prices, prices are for bulk lots such as tank car and motor transport; barge or tanker cargo lot prices are identified; FOB refineries or terminals; in cents per gal. except where shown in bbls. of 42 gals.; ex all fees and taxes; for crude oil and its products lawfully produced and transported; reported as received by *OILGRAM* and National Petroleum News but not guaranteed; for subscribers' private use only and not for resale or distribution or publication. For further details of price conditions apply to any *NPN-OILGRAM* office or see back of any *OILGRAM* Price Service invoice.

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Refinery Prices

Gasoline —U. S. Motor (A S T M) except where otherwise specified

Prices in Effect	Nov. 1	Oct. 25
OKLAHOMA		
78 oct. Ethyl	6.75	6.75
72-74 oct.	6	6
63-66 oct.	5.625 (2)	5.625 (2)
60 oct. & below	5.25	5.25
60-62, 400 e.p.	5.25 (1)	5.25 (1)
MID-WESTERN (Group 3 basis)		
78 oct. Ethyl	6.75 – 7.25	6.75 – 7.25
72-74 oct.	6	6
63-66 oct.	5.6 – 5.625	5.6 – 5.625
60 oct. & below	5.2 – 5.25	5.2 – 5.25
N. TEX. (For shpt. to Tex. & N. M. dest'ns.)		
78 oct. Ethyl	7	7
72-74 oct.	6	6
63-66 oct.	5.625 (2)	5.625 (2)
60 oct. & below	5.2 – 5.25	5.2 – 5.25
60-62 400 e.p.	5.375 (1)	5.375 (1)
W. TEX. (For shpt. to Tex. & N. M. dest'ns.)		
78 oct. Ethyl	6.75 – 7 (2)	6.75 – 7 (2)
72-74 oct.	6	6
63-66 oct.	5.75 (1)	5.75 (1)
60 oct. & below	5.25	5.25
CENT. W. TEX. (Prices to truck transports)		
80 oct. & above	7 (2)	7 (2)
72-74 oct.	6 (2)	6 (2)
67-69 oct.	....	....
62 oct. & below	5.25 (2)	5.25 (2)
AMARILLO, TEX. (For shpt. to W. Okla. & Tex. differential territory.)		
60 oct. & below	No Price	No Price
60-62, 400 e.p.	No Price	No Price
KANSAS (For Kansas destinations only)		
78 oct. Ethyl	7.25 – 7.5 (2)	7.25–7.5 (2)
72-74 oct.	6 – 6.3 (2)	6 – 6.3 (2)
63-66 oct.	5.625–5.9 (2)	5.625–5.9 (2)
60 oct. & below	5.25 – 5.5 (2)	5.25 –5.5 (2)
ARK. (For shipment to Ark. & La.)		
72-74 oct., leaded	6 (1)	6 (1)
70-72 oct. "	5.875 (1)	5.875 (1)
62 oct. "	5.5 (1)	5.5 (1)
60 oct. & below, leaded	5.5 (1)	5.5 (1)
WESTERN PENNA. (Motor gasoline)		
Bradford-Warren:		
"Q" Gasoline, Min. 70 Oct. (ASTM)	7.5 – 8.95	7.5 – 8.95
Other districts:		
"Q" Gasoline, Min. 70 Oct. (ASTM)	7.5 – 7.75	7.5 – 7.75
CENTRAL MICHIGAN (FOB Central Mich. refinery group basis for shpt. within Mich.; shpts. may originate at plants outside Central group.)		
U.S. Motor: (Oct. ASTM):		
72-74 oct.	8 – 8.5	8 – 8.5
67-69 oct.	....	....
Str. run gasoline, excluding Detroit shpt.	6	6
OHIO (S. O. Ohio quotations for statewide delivery and subject to exceptions for local price disturbances).		
72-74 oct.	8.375	8.375
CALIFORNIA U.S. Motor:		
78 oct. & above (Ethyl)	7 – 8.75	7 – 8.75
70-75 oct. (regular)	6 – 7.75	6 – 7.75
65 oct. & below (3rd grade)	5 – 6.75	5 – 6.75

Kerosine, & Gas Fuel Oils

Prices in Effect	Nov. 1	Oct. 25
OKLAHOMA		
41-43 grav. w.w.	4.375	4.375
42-44 grav. w.w.	4.5	4.5
Range Oil	4 – 4.125	4 – 4.125
No. 1 P.W.	....	....
No. 1 straw	....	....
No. 2 straw	3.625	3.625
No. 3 fuel	3.5 (2)	3.5 (1)
U. G. I. Gas Oil	....	....
No. 6 fuel	....	....
14-16 fuel	$0.97 (2)	$0.97 (1)
MID-WESTERN (Group 3 basis)		
41-43 grav. w.w.	4.375	4.375
42-44 grav. w.w.	4.5	4.5
Range Oil	4 –4.1 (2)	4 –4.1 (2)
No. 1 p.w.	3.875	3.875
No. 2 straw	3.625	3.625
No. 3	3.5 (1)	3.5 (1)
No. 5	$0.85 (1)	$0.85 (1)
No. 6	$0.80 (2)	$0.80 (2)
N. TEX. (For shpt. to Tex. & N. M. dest'ns.)		
41-43 grav. w.w.	4 (1)	4 (1)
No. 1 P.W.	4.2 (1)	4.2 (1)
AMARILLO, TEX. (For shpt. to W. Okla. & Tex. differential territory.)		
41-43 grav. w.w.	No Price	No Price
No. 1 straw	No Price	No Price
KANSAS (For Kansas destinations only).		
41-43 grav. w.w.	No Price	No Price
42-44 grav. w.w.	4.7–4.875 (2)	4.7–4.875 (2)
No. 1 p.w.	4.1–4.25 (2)	4.1–4.25 (2)
No. 6 fuel	$0.85 (2)	$0.85 (2)
ARK. (For shipment to Ark. and La.)		
41-43 grav. w.w.	4.625 (1)	4.625 (1)
No. 1	4 (1)	4 (1)
No. 2	3.5 (1)	3.5 (1)
No. 3 fuel	3.5 (1)	3.5 (1)
Tractor fuel, for shpt. to Ark. points only	5.125 (1)	5.125 (1)
WESTERN PENNA.		
Bradford-Warren:		
45 grav. w.w.	6.55 – 8.05	6.55 – 8.05
46 grav. w.w.	6.675 (1)	6.675 (1)
No. 1 fuel	6.55 – 8.05	6.55 – 8.05
No. 2 "	6.625–7.625(2)	6.625–7.625(2)
No. 3 "	6.625–7.75 (2)	6.625–7.75 (2)
36-40 gravity	6.625–6.75 (2)	6.625–6.75 (2)
Other districts:		
45 grav. w.w.	6.75 – 7.925	6.75 – 7.925
46 grav. w.w.	6.875– 7	6.875– 7
47 grav. w.w.	7 – 7.25	7 – 7.25
No. 1 fuel	6.5 – 6.625	6.5 – 6.625
No. 2 "	6.5 – 7.125	6.5 – 7.125
No. 3 "	6.5 – 7.125	6.5 – 7.125
36-40 grav., Pittsburgh dist. prices excluded	6.5 – 7	6.5 – 7
CENTRAL MICHIGAN (FOB Central Mich. refinery group basis for shpt. within Mich.; shpts. may originate at plants outside Central group.)		
47-49 gravity w.w.	5.8 – 6	5.8 – 6
P.W. Distillate	5.5	5.5
No. 3 gas oil, Straw	5	5
U.G.I. gas oil	4.5 (2)	4.5 (2)
Fuel Oils (*Vis. at* 100).		
300-500 Vis.	....	....
100-300 Vis.	4.5	4.5
OHIO (S. O. quotations for statewide delivery)		
Kerosine	7	7
CALIFORNIA		
40-43 grav. w.w.	5 – 7	5 – 7
San Joaquin Valley:		
Heavy fuel	$1.10 (2)	$1.10 (2)
Light fuel	$1.20 (2)	$1.20 (2)
Diesel fuel	4 (2)	4 (2)
Stove dist.	5 (2)	5 (2)
Los Angeles:		
Heavy fuel	$1.10 (2)	$1.10 (2)
Light fuel	$1.20 (2)	$1.20 (2)
Diesel fuel	4 (2)	4 (2)
Stove dist.	5	5
San Francisco:		
Heavy fuel	$1.15 (1)	$1.15 (1)
Light fuel	$1.25 (1)	$1.25 (1)
Diesel fuel	4.5 (1)	4.5 (1)
Stove dist.	5.5 (1)	5.5 (1)

NOTE: All above heavy fuels meet Pacific specification 400; light fuel, spec. 300; Diesel fuels, spec. 200; and stove distillate, spec. 100.

Lubricating Oils

Prices in Effect	Nov. 1	Oct. 25
WESTERN PENNA.		
Prices are for sales made, or offers reliably reported, to jobbers & compounders only. **Viscous Neutrals**—*No. 3 col. Vis. at* 70°*F.*		
200 Vis. (180 at 100°) 420-425 fl.		
0 p.t.	33 (1)	33 (1)
10 p.t.	32 (1)	32 (1)
15 p.t.	31 (1)	31 (1)
25 p.t.	27–30	27–28
150 Vis. (143 at 100°) 400-405 fl.		
0 p.t.	31 (1)	31 (1)
10 p.t.	30 (1)	30 (1)
15 p.t.	29 (1)	29 (1)
25 p.t.	25-28	25–26
Cylinder Stocks		
Brt. stk., 145-155 *vis. at* 210°, 540-550 fl., *No.* 8 *col.*		
10 p.t.	30.5 (1)	30.5 (1)
15 p.t.	29.5 (1)	29.5 (1)
25 p.t.	25	25
600 S.R. filterable	15	15
650 S.R.	15.5	15.5
600 fl.	16	16
630 fl.	17	17
MID-CONTINENT (F. o. b. Tulsa)		
Neutral Oils (*Vis. at* 100° *F. 0 to* 10 *P.P.*)		
Pale Oils:		
Vis. Color		
60-85—No. 2	8	8
86-110—No. 2	8.5	8.5 (2)
150—No. 3	14.5	14.5
180—No. 3	15	15
200—No. 3	15	15
250—No. 3	16–16.5	16–16.5
280—No. 3	17	17
300—No. 3	18	18 (2)
Red Oils:		
180—No. 5	15 (1)	15 (1)
200—No. 5	15 (1)	15 (1)
280—No. 5	No Price	No Price
300—No. 5	17.5 (2)	17.5 (2)

Note: Viscous Neutrals, 15-25 p.p. generally are quoted 0.5c under 0-10 p.p. oils. Non-viscous oils, 15-25 p.p.; generally are quoted 0.25c under 0-10 p.p. oils.

Bright Stock—*Vis. at* 210°		
200 Vis. D	27 (1)	27 (1)
150-160 Vis. D:		
0 to 10 p.p.	23	23
10 to 25 p.p.	22.5–23	22.5–23
25 to 40 p.p.	23 (1)	23 (1)
150-160 Vis. E	22 (1)	22 (1)
120 Vis. D:		
0 to 10 p.p.	22 (2)	22 (2)
600 S.R. Dark Green	8.5 (1)	8.5 (1)
600 S.R. Olive Green	10–11	10–11
631 S.R.	.....	.....
Black Oil	5.5 (1)	5.5 (1)

QUALIFYING PRICE NOTE: Prices on neutrals are posted prices from which refiners allow special discounts, ranging to 3c to meet varying local competition.

SOUTH TEXAS Neutral Oils

Pale Oils (*Vis. at* 100°*F.*)

Vis. Color		
100 No. 1½-2½	6.5	6.5
200 No. 2-3	8.75	8.75
300 No. 2-3	9.25	9.25
500 No. 2½-3½	10	10
750 No. 3-4	10.25	10.25
1200 No. 3-4	10.375	10.375
2000 No. 4	10.5	10.5

(Continued on next page)

NOTE—Parenthetical figures after prices indicate number of companies quoting when less than three companies are quoting.

NOTICE—Owing to great demand, refiners generally limit quotations to regular customers and refuse bids, though higher, from others. Refiners' prices and sales shown) bids reported in market leads

Refinery Prices (Continued)

Prices in Effect	Nov. 1	Oct. 25
Red Oils:		
100 No. 5-6	6.5 (2)	6.5 (2)
200 No. 5-6	8.75	8.75
300 No. 5-6	9.25	9.25
500 No. 5-6	10	10
750 No. 5-6	10.25	10.25
1200 No. 5-6	10.375	10.375
2000 No. 5-6	10.5–11.5	10.5–11.5

CHICAGO (From Mid-Continent p.l. crude.)
Neutral oils (*Vis. at 100° F. 0 to 10 p.p.*)

Pale Oils Vis. Color		
60-85—No. 2	9.5 (1)	9.5 (1)
86-110—No. 2	10 (1)	10 (1)
150—No. 3	15.5 (1)	15.5 (1)
180—No. 3	16 (1)	16 (1)
200—No. 3	16 (1)	16 (1)
250—No. 3	17 (1)	17 (1)
Red Oils:		
180—No. 5	16 (1)	16 (1)
200—No. 5	16 (1)	16 (1)
250—No. 5	17 (1)	17 (1)
280—No. 5	18 (1)	18 (1)
300—No. 5	18.5 (1)	18.5 (1)

Note: Viscous oils, 15 to 30 p.p. are quoted 0.5c lower: 60-85 and 86-110 No. 2 non-viscous oils, 15 to 30 p.p., 0.25c lower.

Unfiltered Steam Refined: (*Viscosity at 210°*)		
140	11.5 (1)	11.5 (1)
160	12.5 (1)	12.5 (1)
200	13.5 (1)	13.5 (1)
Bright stocks, 160 *vis. at 210 No. 8 color*:		
0 to 10 p.p.	24 (1)	24 (1)
15 to 25 p.p.	23.5 (1)	23.5 (1)
30 to 40 p.p.	21.5 (1)	21.5 (1)
E filtered Cyl. Stock	15.5 (1)	15.5 (1)

Note: To obtain prices delivered in Chicago, add 0.25c per gal.

Natural Gasoline

(Group 3 & Breckenridge prices are to blenders on freight basis shown below. Shipments may originate in any Mid-Continent manufacturing district.)

FOB GROUP 3		
Grade 26-70	4.75 (Sale)	4.75 (Sale)
FOB BRECKENRIDGE		
Grade 26-70	4.375 (Quote)	4.375 (Quote)
CALIFORNIA (FOB plants in Los Angeles basin)		
21 pound vapor pressure for blending	4.75 – 5.375	4.75 – 5.375

Naphtha and Solvent

(*FOB Group 3*)		
Stoddard solvent	6.625	6.625
Cleaners' naphtha	7.125	7.125
V. M. & P. naphtha	7.1 – 7.125	7.1 – 7.125
Mineral spirits	6.1 – 6.125	6.1 – 6.125
Rubber solvent	7.1 – 7.125	7.1 – 7.125
Lacquer diluent	7.375–8.125	7.375–8.125
Benzol Diluent	8.375–8.625	8.375–8.625
WESTERN PENNA.		
Bradford-Warren District:		
Stoddard Solvent	7.5 (1)	7.5 (1)
Other Districts:		
Untreated naphtha	7 – 7.25	7 – 7.25
Stoddard solvent	7 – 7.75	7 – 7.75

OHIO (S. O. quotations for statewide delivery): V.M.&P. naphtha, D.C. naphtha, Varnolene &

Sohio solvent	10	10
Rubber solvent	9	9

Wax

WESTERN PENNA. (Bbls. C.L.)

White Crude Scale:		
122-124 A.m.p.	4.25 (2)	4.25 (2)
124-126 A.m.p.	4.25	4.25
OKLAHOMA (C.L. FOB Refinery)		
Semi-refined:		
128 AMP min. white, 50 kilo bags	No Price	No Price
132-134 AMP, bbls.	5.25 (1)	5.25 (1)

CHICAGO (FOB Chicago district refinery of one refiner, in bags, carloads. Carloads, slabs loose 0.4c less. Melting points are EMP (ASTM) methods; add 3° to convert into AMP.)

Fully refined:		
122-124 (bags only)	5.6	5.6
125-127	6	6
127-129	6.25	6.25
130-132	6.55	6.55
132-134	6.8	6.8
135-137	7.55	7.55

Petrolatums

WESTERN PENNA. (Bbls., carloads; tank cars, 0.5c per lb. less.)

Snow White	6.125– 7.25	6.125– 7.25
Lily White	5.375– 6.125	5.375– 6.125
Cream White	4.375– 5.375	4.375– 5.375
Light Amber	3.375– 3.875	3.375– 3.875
Amber	3.125– 3.625	3.125– 3.625
Red	3 – 3.5	3 – 3.5

Tank Wagon Prices

Commercial or consumer tank car, tank wagon, dealer, and service station prices for gasoline **do not include taxes;** *they do, however, include inspection fees as shown in general footnote. Gasoline taxes, shown in separate column, include 1.5c federal, and state taxes also city and county taxs as; indicated in footnotes. Kerosine tank wagon prices also do not include taxes; kerosine taxes where levied are indicated in footnotes. Dealer discounts are shown in footnotes. These prices in effect Nov. 1, 1943 as posted by principal marketing companies at their headquarters offices, but subject to later correction.*

S. O. N. J.

Esso (*Regular Grade*)	Consumer Tank Wagon	Dealer T.W.	Gasoline Taxes	Kerosine T.W.
*Atlantic City, N. J.	10.2	10.7	4.5	10
*Newark, N. J.	10.2	10.7	4.5	10
Annapolis, Md.	10.55	11.05	5.5	....
Baltimore, Md.	9.95	10.45	5.5	10.8
Cumberland, Md.	11.35	11.85	5.5	12.3
Washington, D. C.	10.2	10.7	4.5	11.3
Danville, Va.	11.65	12.15	6.5	12.55
Norfolk, Va.	10.45	10.95	6.5	12.3
Petersburg, Va.	10.75	11.25	6.5	13.3
Richmond, Va.	10.75	11.25	6.5	13.3
Roanoke, Va.	11.95	12.45	6.5	12.8
Charleston, W. Va.	12.25	12.75	6.5	13.6
Parkersburg, W. Va.	11.55	12.05	6.5	13.3
Wheeling, W. Va.	11.55	12.05	6.5	13.9
Charlotte, N. C.	12.1	12.6	7.5	11.6
Hickory, N. C.	12.65	13.15	7.5	12.6
Mt. Airy, N. C.	12.5	13.0	7.5	11.8
Raleigh, N. C.	11.85	12.35	7.5	12.6
Salisbury, N. C.	12.15	12.65	7.5	13.0
Charleston, S. C.	10.95	11.45	7.5	....
Columbia, S. C.	11.8	12.3	7.5	....
Spartanburg, S. C.	12.5	13.0	7.5	....

	Mineral Spirits T.W.	V.M.&P. T.W.
Newark, N. J.	13	14.5
Baltimore, Md.	15.5	....
Washington, D. C.	15.5	....

Fuel Oils—T.W.	No. 1	No. 2	No. 3
Atlantic City, N. J.	10	9	9
Newark	10	9	9
Annapolis, Md.	..	9.25	...
Baltimore	9.8	9	9
Washington, D. C.	10.3	9.4	9.4
Norfolk, Va.	10	8.8	8.8
Petersburg	10.3	9	...
Richmond	10.3	9	9
Charlotte, N. C.	10.6	10.4	...
Hickory, N. C.	....	10	...
Raleigh	11.6	10.1	...
Charleston, S. C.	....	9	...
Columbia	....	10	...
Spartanburg	....	10.8	...

*Effective Aug. 5, '42 minimum retail resale price of 14.2c posted thru New Jersey.

Discounts:

Esso gasoline—to undivided dealers, 0.5c off dealer t.w.

Kerosine—1c off t.w. price for 25 gals. or more, under contract thru territory (Baltimore city contract not necessary) except no discount in state of New Jersey.

Naphthas—To buyers taking following quantities at one time: Newark, 2c per gal. on 200 gals. or more, less than 200 gals, 0.5c higher price; Baltimore, 2c off on 25 to 100 gals. and 3c on over 100 gals.; Washington, 2c off to contract buyers.

(N.B. Prices are Continental's "structural" prices. Prices do not reflect temporary reductions made to meet local competition.)

Notice

These prices include inspection fees on both gasoline and kerosine unless otherwise specified per gallon as follows:

Ala. 1/40c on gasoline, 1/2c on kerosine; Ark. 1/20c; Fl. 1/8c; Ill. 3/100c; Ind. 1/5c in lots of 25 bbls. or less, 2/25c in lots of more than 25 bbls.; Kans. 1/50c; La. 1/32c; Minn. 7/20c; Mis. 1/50c; Neb. 2/100c; Nev. gasoline 1/20c; N. C. 1/4c; N. Da. 1/20c; Okla. 2/25c; S. Car. 1/8c; S. Da. 1/20c; Tenn. 2/5c; and Wisc. 3/100c.

Kerosine inspection fees only: Iowa 3/50c; Mich. 1/5c per gal.

CONT'L OIL

	Conoco Bronz-z-z (*Reg.*) †Tank Wagon	Demand (*3rd Grade*)	Gasoline Taxes	Kerosine T.W.
Denver, Col.	11	10	5.5	11
Grand Junc., Col.	12	11	5.5	12
Pueblo, Col.	10.5	9.5	5.5	10.5
Casper, Wyo.	11.5	10.5	5.5	12
Cheyenne, Wyo.	11	10	5.5	11.5
Billings, Mont.	12.5	11.5	6.5	12.5
Butte, Mont.	13.5	12.5	6.5	13.5
Great Falls, Mont.	12.5	11.5	6.5	12.5
Helena, Mont.	13	12	6.5	13
Salt Lake City, Utah	13.5	12.5	5.5	14.5
Boise, Ida.	14.1	13.1	6.5	16.5
Twin Falls, Ida.	15.6	14.6	6.5	17
Albuquerque, N. M.	10	9	*7	9.5
Roswell, N. M.	9.5	8.5	*7	9
Santa Fe, N. M.	10.5	9.5	*7.5	10
Ft. Smith, Ark.	9.5	9.25	*7	9.5
Texarkana, Ark.	9	8	*5.5	9
Muskogee, Okla.	9.5	8.5	7	8.5
Oklahoma City, Okla.	9.5	8.5	7	8.5
Tulsa, Okla.	9.5	8.5	7	8.5

*Taxes: In gasoline tax column are included these city taxes—Albuquerque, & Roswell, 0.5c Santa Fe, 1c. Texas 4c state tax applies within city limits of Texarkana, Ark.; Okla. 5.5c state applies within city limits of Ft. Smith, Ark.

†To consumers & Dealers.

S. O. NEB.

(*Regular Grade*)	T.W.	Dealer	Gasoline Taxes	Kerosine T.W.
Omaha	11.4	9.6	6.5	10.1
McCook	12.0	10.1	6.5	10.4
Norfolk	11.9	10.4	6.5	10.6
North Platte	12.3	10.6	6.5	11
Scottsbluff	12.9	10.2	6.5	10.5

Standard Gasoline (*Regular Grade*)
Flight Gasoline (*Third Grade*)

S. O. CAL.

	Standard Posted Net Tank Truck	Standard Posted Retail	Flight Posted Net Tank Truck	Flight Posted Retail	Gasoline Taxes
San Francisco, Cal.	10	14	9	12	4.5
Los Angeles, Cal.	9.5	13.5	8.5	11.5	4.5
Fresno, Cal.	11	15	10	13	4.5
Phoenix, Ariz.	12	16	10	13	6.5
Reno, Nev.	12	16	11	14	5.5
Portland, Ore.	10.5	14.5	9.5	12.5	6.5
Seattle, Wash.	10.5	14.5	9.5	12.5	6.5
Spokane, Wash.	12.5	16.5	11.5	14.5	6.5
Tacoma, Wash.	10.5	14.5	9.5	12.5	6.5

Std. Aviation 73

	Posted Net Tank Truck	Gasoline Taxes	Kerosine Tank Truck
San Francisco, Cal.	12.5	4.5	11.5
Los Angeles, Cal.	12	4.5	10
Fresno, Cal.	13.5	4.5	12.5
Phoenix, Ariz.	14.5	6.5	12.5
Reno, Nev.	14.5	5.5	13.5
Portland, Ore.	13	6.5	13.8
Seattle, Wash.	13	6.5	13.8
Spokane, Wash.	16	6.5	16.8
Tacoma, Wash.	13	6.5	13.8

Resale & Commercial: T.C. deliveries 0.25c per gal. off posted net tank truck.

Commercial: Retail deliveries, and/or tank truck deliveries of less than 40 gals., 4c per gal. above posted net tank truck price for Standard Aviation and Standard Gasoline, and 3c per gal. above posted net tank truck for Flight Gasoline, except single deliveries of less than 40 gals. to Marine trade only, which are billed at posted net tank truck price.

TEXAS CO.

	Gasoline—Dealer T.W. Fire-Chief (*Regular*)	Indian (*3rd Grade*)	Gasoline Taxes
Dallas, Tex.	7.5	6.5	5.5
Ft. Worth, Tex.	7.5	6.5	5.5
Wichita Falls, Tex.	8.5	7.5	5.5
Amarillo, Tex.	8.5	7.5	5.5
Tyler, Tex.	8.5	7.5	5.5
El Paso, Tex.	11	10.5	5.5
San Angelo, Tex.	8.5	7.5	5.5
Waco, Tex.	8.5*	7*	5.5
Austin, Tex.	8.5	7.5	5.5
Houston, Tex.	8.5	7.5	5.5
San Antonio, Tex.	8.5	7.5	5.5
Port Arthur, Tex.	8.5	7.5	5.5

*Less 1c temporary allowance to all dealers.

(Continued on next page)

Tank Wagon Prices (Continued)

S. O. IND.

Red Crown (*Regular Grade*)
Blue Crown (*Third Grade*)

	Red Crown Cons.	Red Crown	Blue Crown	Gasoline Taxes	Kerosine T.W.
Chicago, Ill.	11 6	9 6	9 1	4.5	10.6
Decatur, Ill.	11 6	9 6	8.7	4.5	10.3
Joliet, Ill.	11 9	10 3	9 2	4.5	10 4
Peoria, Ill.	11.7	9.9	9.7	4.5	10.4
Indianapolis, Ind.	11.6	10.1	9 6	5.5	10.1
Evansville, Ind	11.4	9.9	8.6	5.5	9.9
South Bend, Ind.	12	10.5	10	5 5	10.5
Detroit, Mich.	11.4	9.9	9.4	4.5	10
Grand Rapids, Mich.	11.4	9.9	9.4	4 5	9.9
Saginaw, Mich.	11.4	9.9	9.4	4.5	9.9
Green Bay, Wis.	12.2	10.7	10.2	5.5	10.9
Milwaukee, Wis.	12.1	10.6	10.1	5.5	10.8
La Crosse, Wis.	11.9	10.4	9.9	5.5	10.6
Minneapolis - St. Paul.	11 9	10.4	9 9	5.5	10.6
Duluth, Minn.	12.2	10.7	10.2	5.5	10.9
Mankato, Minn.	11.9	10.4	9 9	5.5	10.6
Des Moines, Ia.	11.4	9.9	9.4	4.5	*10.1
Mason City, Ia.	11.7	10.2	9.7	4.5	*10.4
St. Louis, Mo.	11 0	9.5	9.3	*4.5	10.1
Kansas City, Mo.	11.0	9.5	8.6	*4.5	9 7
St. Joseph, Mo.	11.2	9.7	9.2	*4.5	9.9
Fargo, N. D.	12.9	11.4	10 9	5.5	11.6
Huron, S. D.	12.3	10.8	10.3	5.5	11
Wichita, Kans.	10.3	8.8	7.2	4.5	8.7

Stanavo Aviation 73 Octane

Chicago, Ill.	15.7	4.5
Milwaukee, Wis.	15.9	5.5
Minneapolis, Minn.	15.7	5.5
St. Louis, Mo.	15.2	*4.5
Kansas City, Mo.	14.8	*4.5
Fargo, N. D.	16.7	5.5
Huron, S. D.	16.1	5.5

(Prices are base prices before discounts)

	Oleum Spirits	V.M.&P. Naphtha	Stanisol	*Taxes
Chicago	13.5	13.8	12.8	4.5
Detroit	15.8	15	16.3	4.5
K. C., Mo.	13.3	14.3	13.8	3.5
St. Louis, Mo.	13.7	14.7	13.2	3.5
Milwaukee	14.4	15.4	14.9	5.5
Minneap'ls	14.2	15.2	13.5	5.5

Fuel Oils T.W. Chicago

	Standard Heater Oil
1-99 gals.	9.3
100-149 gals.	8.3
150 gals. & over	7.8

	Stanolex Fuel Oil No. 1	Stanolex Furnace Oil
1-99 gals.	8.8	8.8
100-149 gals.	7.8	7.8
150-399 gals.	7.8	7.8
400 gals. & over	7.3	7.3

	Stanolex Fuel Oil A	Stanolex Fuel Oil B
1-99 gals.	8.3	8.3
100-399 gals.	7.3	7.3
400-749 gals.	6.3	6.3
750 gals. & over	5.55	5.55

	Stanolex Bunker C Fuel Oil
1-399 gals.	6 8
400-999 gals.	5.8
1000 gals. & over	4.8

Other Points Indianapolis	Stanolex Furnace Oil
1-99 gals.	9.0
100 gals. & over	8.0
Detroit	
1-99 gals.	8.7
100 gals. & over	7.7
Milwaukee	
1-99 gals.	9.0
100 gals. & over	8.0
Minneapolis	
1-99 gals.	9.1
100 gals. & over	8.1
St. Louis	
1-99 gals.	8.1
100 gals. & over	7.1
Kansas City	
1-99 gals.	8.1
100 gals. & over	7.1

*Taxes: In gasoline tax column are included these city taxes—Kansas City, St. Joseph and St. Louis, 1c. Iowa kerosine prices are ex 3c state tax. In naphtha tax column are included 1.5c federal tax and state taxes.

State sales, occupation, consumer and use taxes to be added when applicable.

HUMBLE OIL

Humble Motor Fuel (*Regular Grade*)
Thriftane (*Third Grade*)

	Humble *Tank Wagon	Humble Retail	Thriftane *Tank Wagon	Thriftane Retail	Gasoline Taxes
Dallas, Tex.	7.5	10.5	6.5	10.5	5.5
Ft. Worth, Tex.	6.5	9.5	6	7.5	5.5
Houston, Tex.	8.5	12.5	7.5	10.5	5.5
San Ant., Tex.	8.5	12.5	7.5	10.5	5.5

	Kerosine *Tank Wagon	Kerosine Retail
Dallas, Tex.	7	10
Ft. Worth, Tex.	7	11
Houston, Tex.	8	11
San Antonio, Tex.	7	10

73 Oct. Aviation Gasoline	Tank Car
FOB Baytown, Tex.	8.5

*To all classes of dealers & consumers.

Fuel oils—Statewide prices are for t.w. & drum deliveries of 50 gals. or more; prices for deliveries of less than 50 gals. are 0.5c higher. Cleveland Division assumed the state-wide fuel oil tank wagon prices on Nos. 1, 2 and 3 fuel oil, effective May 10. However the price of 7.55c per gallon and No. 4 fuel oil (full compartment hose dumps only) will remain as heretofore, in Cleveland Division.

Naphthas—to contract consumers off t.w. prices—Statewide: 300 to 999 gals., 0.5c; 1000 to 2499 gals., 0.75c; 2500 to 4999 gals., 1c; 5000 or more gals., 1.5c. Lucas County: Less than 50 gals., tank wagon price, 50 to 249 gals., 0.5c; 250 to 499 gals., 1c; 500 gals. or over, 1.5c.

S. O. OHIO

*Sohio X-70 Gasoline (*Regular Grade*)

	Consumer T.W.	**Resellers	Gasoline ‡S.S. Taxes	†Kerosine T.W.
Ohio, Statewide	12	10	13.5	5.5	9.3
Akron	12	9.5	12.5	5.5	9.3
Cincinnati	12	9.5	12.5	5.5	9.3
Cleveland	12	9.5	12.5	5.5	9 3
Columbus	12	9.5	12.5	5.5	9.3
Dayton	12	9.5	12.5	5.5	9.3
Marietta	12	9.5	12.5	5.5	9.3
Portsmouth	12	9.5	12.5	5.5	9.3
Toledo	12	9.5	12.5	5.5	9 3
Youngstown	12	9.5	12.5	5.5	9.3

Aviation Gasoline—Statewide

	Consumer Gasoline T.W.	Taxes
Sohio aviation grade 65 octane, Spec. AN-VV-F-756	14.5	5.5
Esso Ethyl Aviation 73 Oct.	15.5	5.5
Esso Ethyl Aviation 80 Oct.	16.5	5.5
Esso Ethyl Aviation 87 Oct.(a)	17.5	5.5
Esso Ethyl Aviation 91 Oct.	17.5	5.5
Esso Ethyl Aviation 100 Oct.	24.5	5.5

(a) Effective Oct. 15, 1942.

	†Naphtha—T.W. Statewide	Lucas County
S. R. Solvent	13.5	13.5
D. C. Naphtha	14.5	14.25
V.M.&P. Naphtha	14.5	14.25
Varnolene	14.5	14.25
Sohio Solvent	14.5	14.25

Fuel Oils—T.W.	No. 1	No. 2	No. 3	No. 4
Ohio, Statewide	8.3	8.3	7.8	7.55*

*Renown (third-grade) prices are same as X-70 unless otherwise noted.

**Except authorized agents.

†Kerosine prices are ex 1c state tax. Naphtha prices are ex 1.5c federal & 4c state tax.

‡Prices at company-operated stations.

††Statewide prices are subject to exceptions other than those shown.

Discounts:

Esso aviation—on contract to hangar operators and resellers, 2c off consumer t.w.

* For Cleveland area only.

Canada

PRICES OF IMPERIAL OIL, LTD.

Per Imperial Gallon, which is 1.2 U. S. Gallons

IMPERIAL OIL

3-Star Imperial Gasoline (*Regular Grade*)

	†Gasoline T.W.	*Gasoline Taxes	†Kerosine T.W.
Hamilton, Ont.	17.5	11	18
Toronto, Ont.	17.5	11	18
Brandon, Man.	21	10	23
Winnipeg, Man.	20.5	10	22.5
Regina Sask.	18	10	20
Saskatoon, Sask.	20.8	10	22.8
Edmonton, Alta.	18.9	10	20.9
Calgary, Alta.	16	10	18
Vancouver, B. C.	15	10	24
Montreal, Que.	17	11	17.5
St. John, N. B.	16.5	13	19
Halifax, N. S.	16.5	13	19

*Includes 3c Federal, and Provincial taxes.
†To divided & undivided dealers.

ATLANTIC REFINING

Atlantic White Flash Gasoline (*Regular Grade*)

	Commercial T.W.	Dealer T.W.	Gasoline Taxes	Kerosine T.W.
Philadelphia, Pa.	10 2	10.7	5.5	12 25
Pittsburgh	10.7	11.2	5.5	12.6
Allentown	10.7	11.2	5.5	12.6
Erie	10.7	11.2	5.5	12.6
Scranton	10.7	11.2	5.5	12.6
Altoona	10.7	11.2	5.5	12.6
Emporium	10.7	11.2	5.5	12.6
Indiana	10.7	11.2	5.5	12.6
Uniontown	10.7	11.2	5.5	12.6
Harrisburg	10.7	11.2	5.5	12.6
Williamsport	10.7	11.2	5.5	12.6
Dover, Del.	....	11.2	5.5	12.6
Wilmington, Del.	....	10.7	5.5	12.1
Boston, Mass.	....	10.9	5.5	....
Springfield, Mass.	....	11.8	4.5	....
Worcester, Mass.	....	11.5	4.5	....
Fall River, Mass.	....	11	4.5	....
Hartford, Conn.	....	11.6	4.5	....
New Haven, Conn.	....	11	4.5	....
Providence, R. I.	....	11	4.5	....
Atlantic City, N. J.	....	10.7	4.5	10
Camden, N. J.	....	10.7	4.5	10
Trenton, N. J.	....	10.7	4.5	10
Annapolis, Md.	....	11.05	5.5	10 8
Baltimore, Md.	....	10.45	5.5	9.8
Hagerstown, Md.	....	11.55	5.5	10.3
Richmond, Va.	....	11.25	6.5	12.3
Wilmington, N. C.	11.55	7.5	11.9	....
Brunswick, Ga.	....	10.4	7.5	11.1
Jacksonville, Fla.	....	10.4	8.5	12.1

	Mineral Spirits T.W.†	V.M.X.P. T.W.†
Philadelphia, Pa.	11	12.5
Lancaster, Pa.	12	13.5
Pittsburgh, Pa.	12.5	13.5

Fuel Oils—T.W.

	1	2	3	5	6
Phila., Pa.	10.1	9	9	5.76	5.04*
Allentown, Pa.	10.6	9.3	9.3	....	....
Wilmington, Del.	10.1	9	9	....	....
Springfield, Mass.	10.2	9.4	9.4	....	....
Worcester, Mass.	10.2	9.3	9.3	....	....
Hartford, Conn.	10.5	9	9	....	....

‡Does not include 1c Georgia kerosine tax.
†Mineral Spirits prices also apply to Stoddard Solvent; V.M.&P. prices also apply to Light Cleaners Naphtha.

Discounts:

Gasoline—to undivided dealers, 0.5c off dealer t.w., except Georgia & Florida dealer t.w. and undivided dealer t.w. prices are same.

Kerosine—Thru Penna. & Delawa re, 2c off t.w. price on t.w. deliveries of 25 gals. or more at one time.

*Residual fuel 13.0-15.9 gravity effective 10/17/43.

S. O. KY.

Crown Gasoline (*Regular*)
Standard (*Third Grade*)

	†Net Crown	Dealer Standard	Gasoline Taxes	Kerosine T.W.
Covington, Ky.	9.5	...	6.5	9.3
Lexington, Ky.	10.5	8.5	6.5	9.3
Louisville, Ky.	10	...	6.5	8 8
Paducah, Ky.	10	8	6.5	8.8
Jackson, Miss.	10	9	7.5	*9
Vicksburg, Miss.	9.5	...	7.5	*8.5
Birmingham, Ala.	10	9	*8.5	9
Mobile, Ala.	9	...	*9.5	8.5
Montgomery, Ala.	10	9	*9.5	10
Atlanta, Ga.	11.4	...	7.5	*12.1
Augusta, Ga.	11.4	...	7.5	*11.6
Macon, Ga.	11.4	...	7.5	12.1
Savannah, Ga.	10.4	...	7.5	11.1
Jacksonville, Fla.	10.4	...	8.5	10.1
Miami, Fla.	10.4	...	8.5	10.1
Pensacola, Fla.	9	8	*9.5	8
Tampa, Fla.	10.4	...	8.5	10.1

*Taxes: In tax column are included these city and county gasoline taxes: Mobile, 2c city; Birmingham, 1c city; Montgomery, 1c city and 1c county; Pensacola, 1c city. Georgia and Montgomery, Ala. have 1c kerosine tax, Mississippi 0.5c, not included in above prices.
†Consumer t.w. prices are same as net dealer prices.

S. O. LA.

Esso Gasoline (*Regular Grade*)

	Consumer Tank Wagon	Dealer T.W.	Gasoline Taxes	Kerosine T.W.
New Orleans, La.	8.75	9.25	8.5	*9
Baton Rouge, La.	8.75	9.25	8.5	*9.5
Alexandria, La.	8.75	9.25	8.5	*9.5
Lafayette, La.	9	9.5	8.5	*9
Lake Charles, La.	9	9.5	8.5	*11
Shreveport, La.	8.5	9	8.5	*8
Knoxville, Tenn.	9.5	10	8.5	12.5
Memphis, Tenn.	8.90	9.40	8.5	10.5
Chattanooga, Tenn.	10.5	11	8.5	11
Nashville, Tenn.	10.5	11	8.5	10
Bristol, Tenn.	10.95	11.45	8.5	13.1
Little Rock, Ark.	9.5	10	8	10

*Louisiana kerosine prices are ex 1c state tax.
Discounts:
Esso Gasoline—To undivided dealers, 0.5c off dealer t.w.

(Continued on next page)

SEABOARD PRICES EXPORT AND COASTWISE

Atlantic Coast

(Prices are of refiners, FOB their refineries & their tanker terminals, & of tanker terminal operators FOB their terminals)—Prices In Effect Nov. 1

MOTOR GASOLINE

District:	72-74 Oct. (ASTM)	68-70 Oct. (ASTM)
N. Y. Harb.	9.2 – 9.4	9.2 (1)
N. Y. Harb., barges	9.1 – 9.3	9.1 (1)
Albany	9.3 – 9.5	....
Philadelphia	9.2	....
Baltimore	8.95	8.85 (1)
Norfolk	8.7 – 8.95	8.5 (1)
Wilmington, N. C.	8.7 – 8.75	8.5 (1)
Charleston	8.7 – 8.8	8.1 (1)
Savannah	8.25 – 8.4	....
Jacksonville	8.27 –8.4	....
Miami	8.27 (1)	....
Tampa	8.27 – 8.4	8.275 (1)
Pensacola	7 – 7.2 (1)	....
Mobile	7 – 7.2	....
New Orleans	6.125– 6.75	....
Portland	9.5 – 9.65	....
Boston	9.4 – 9.7	9.7 (1)
Providence	9.4 – 9.7	....

FUEL OILS

District:	KEROSINE and/or NO. 1 FUEL	No. 2	No. 3	No. 5	No. 6
N. Y. Harb.	7.1	6.7	6.7	$1.95–$2.01 (a)	$1.65 –$2.07
N. Y. Harb., barges	7	6.6	6.6	....	....
Albany	7.3	6.8	6.8 (2)	$2.25 (1)	$1.85–$2.27 (1)
Philadelphia	7.2	6.7	6.7	$1.98	$1.65 –$2.07
Baltimore	7.2	6.7	6.7	....	$1.65 –$2.07
Norfolk	7.1	6.7	6.7 (1)	....	$1.65–$2.07 (2)
Wilmington, N. C.	7.05	6.7	....	....	....
Charleston	7.2	6.7 (2)	....	....	$1.60–$2.02 (2)
Savannah	7.05	....	....	....	$1.60–$2.02 (1)
Jacksonville	7.05 (2)	6.25	....	....	$1.60–$2.02 (1)
Miami	7.05 (2)	....	....	....	....
Tampa	7.05	6.25 (2)	....	....	$1.50–$1.92 (2)
Pensacola	4.8 (1)	....	....	....	....
Mobile	4.75–5.05 (2)	....	....	....	....
New Orleans	4.25 – 4.75	3.75 (2)	....	$1.27 (1)	$0.85–$1.27 (2)
Portland	7.3	6.8	6.8 (2)	$2.25 (1)	$1.65–$2.07 (1)
Boston	7.2	6.7	6.7 (2)	$1.95–$2.07 (2)	$1.65–$2.07
Providence	7.2	6.7	6.7 (2)	$1.90–$1.95 (2)	$1.65–$2.07

(a) This price is for a straight-run low pour test No. 5 fuel.

Pacific Export

(Quotations at seaboard, Los Angeles, cargo lots except where otherwise noted.)

Prices in Effect	Nov. 1	Oct. 25
Diesel Fuel, Pac. Spec. 200	$1.40 –$1.45	$1.40 – $1.45
Grade C fuel, Pac. Spec. 400	$1.10	$1.10

Tank Wagon Prices—Continued

SOCONY VACUUM

	Socony (Regular Grade) Com. Cons. T.W.	Mobilgas Indiv. Dlr. T.W.	Gasoline Taxes
New York City			
Manhattan & Bronx	10.1	10.6	*5.5
Kings & Queens	10.1	10.6	*5.5
Richmond	9.7	10.2	*5.5
Albany, N. Y.	9.9	10.4	5.5
Binghamton, N. Y.	11	11.5	5.5
Buffalo	10.2	10.7	5.5
Jamestown, N. Y.	10.4	10.9	5.5
Mt. Vernon, N. Y.	10.1	10.6	5.5
Plattsburg, N. Y.	11	11.5	5.5
Rochester, N. Y.	10.8	11.3	5.5
Syracuse, N. Y.	10.5	11	4.5
Bridgeport, Conn.	10	10.5	4.5
Danbury, Conn.	10.5	11	4.5
Hartford, Conn.	10.6	11.1	4.5
New Haven, Conn.	10	10.5	4.5
Bangor, Me.	10.7	11.2	5.5
Portland, Me.	10.3	10.8	5.5
Boston, Mass.	9.9	10.4	4.5
Concord, N. H.	11.4	11.9	5.5
Lancaster, N. H.	12	12.5	5.5
Manchester, N. H.	11.3	11.8	5.5
Providence, R. I.	10	10.5	4.5
Burlington, Vt.	10.9	11.4	5.5
Rutland, Vt.	11	11.5	5.5

	Mineral Spirits T.W.	V.M.&P. T.W.
Buffalo, N. Y.	12.4	13.6
New York City	11	12
Rochester, N. Y.	13.2	14.4
Syracuse, N. Y.	14	....
Boston, Mass.	12	13
Bridgeport, Conn.	†16.3	†17.3
Hartford, Conn.	†16.3	†17.3
Providence, R. I.	13	14

	Kerosine Yard	Kerosine T.W.	Mobilfuel Diesel T.C.	Mobilfuel Diesel T.W.	Mobilheat Fuel Yard	Mobilheat Fuel T.W.
New York:						
Manhat'n & Bronx	7.5	10.3	...	9.3	7.1	9
Kings & Queens	7.5	10.3	...	9.3	7.1	9
Richmond	7.5	10.3	...	...	7.1	8.8
Albany	7.5	9.8	7	9.3	7	9
Binghamton	8.9	11.2	...	10.7	8.4	10.2
Buffalo	8.6	10.9	8	10.3	8.2	10
Jamestown	8.7	11	...	10.6	8.3	10
Mt. Vernon	7.6	10.3	...	9.4	7.2	9
Plattsburg	8.1	10.4	...	9.9	7.6	9.4
Rochester	8.7	11	7.9	10.2	7.9	9.7
Syracuse	8.5	10.8	7.8	10.1	7.8	9.6
Conn.:						
Bridgeport	7.8	10.3	...	....	7.2	8.8
Danbury	8.2	10.8	...	...	7.5	8.8
Hartford	8.0	10.5	...	9.5	7.2	9
New Haven	7.8	10.3	...	9.3	7	8.9
Maine:						
Bangor	7.9	10.2	7.4	9.7	7.4	9.1
Portland	7.5	10.2	7	9.3	7	9
Mass.:						
Boston	7.8	10.6	6.9	9.2	7.1	9
N. H.:						
Concord	8.4	10.7	...	....	8.2	10
Lancaster	9.5	11.8	...	....	9.2	11
Manchester	8.5	11.1	...	....	7.9	9.7
R. I.:						
Providence	7.6	9.9	6.9	9.2	7.1	8.9
Vermont:						
Burlington	8.1	10.4	7.5	9.8	7.5	9.2
Rutland	8.3	10.6	...	10	7.7	9.5

*Does not include 1% city sales tax applicable to price of gasoline (ex tax).

†In steel barrels.

Discounts: Diesel—On t.w. deliveries, 0.5c for at least 400 gals.; 1c for full tank truck.

	Bunker C Fuel Ships' bunkers (Ex Lighterage)	Diesel Oil Ships' bunkers (Ex Lighterage)	Diesel Oil Shore Plants	Gas House Gas Oil 28-34 Gravity
N. Y. Harbor	$1.65–$2.07	$2.78	6.7–6.8 (2)	6.8 (2)
Albany	$1.85 (1)	$2.98 (1)	6.8 (1)	6.7
Philadelphia	$1.65–$2.07	$2.78	....	....
Baltimore	$1.65–$2.07	$2.78	6.7 (1)	6.7 (1)
Norfolk	$1.65–$2.07	$2.78	6.7 (1)	6.7 (1)
Charleston	$1.60–$2.02	$2.78 (2)	6.7 (1)	6.7 (1)
Savannah	$1.60–$2.02 (1)	$2.62 (1)	....	....
Jacksonville	$1.60–$2.02 (2)	$2.62 (2)	....	....
Tampa	$1.50–$1.92	$2.62 (2)	....	....
New Orleans	$0.97–$1.09	$1.65 (1)	4 (1)	....
Portland	$1.65–$2.07 (1)	$2.86 (1)	6.8 (1)	6.9 (1)
Boston	$1.65–$2.07	$2.78	6.7 (2)	6.8 (2)
Providence	$1.65–$2.07	$2.78 (2)	6.7 (1)	6.8 (1)

Residual fuel prices generally vary with A.P.I. specifications from range low for 9.9 & below degrees to range high for 25.0 & above.

Gulf Coast

Prices in Effect Nov. 1

MOTOR GASOLINE	New Orleans & Lower Mississippi to Baton Rouge Tank Cars	New Orleans & Lower Mississippi to Baton Rouge Barge	Texas Gulf Coast South of New Orleans Tank Cars	Texas Gulf Coast South of New Orleans Barges	CARGOES Domestic & Export From all Gulf Ports
Leaded (oct. by ASTM)					
80 oct. min. Max. 3 cc lead	6.75	6.5 – 6.75	6.75	6.75	6.25 – 6.75
72-74 oct.	6.125	5.75	5.75	5.75	5.75
63-65 oct.	....	....	....	....	....
Unleaded 70 oct.	....	....	....	....	5.625– 5.75
67-68 oct.	....	....	....	....	5.5 – 5.625
65 oct.	....	....	....	....	5.25
60 oct.	....	....	....	....	5
KEROSINE & LIGHT FUELS					
41-43 w.w. kero.	4.125–4.25	4.125	4.125– 4.25	4.125	4.125
42-44 w.w. kero.	....	....	4.125	4.125	4.125
No. 2 fuel oil	3.75	3.75	3.75 – 4	3.75	3.75
DIESEL & GAS OILS					
(In diesel index No.)					
Below 43 di.	....	....	....	....	....
43-47 di.	....	....	....	....	4
48-52 di.	4	4	4	4	4
53-57 di.	4.125	4.125	4.125	4.125	4.125
58 and above	4.25	....	4.25	....	4.25

HEAVY FUELS & In Cargoes BUNKER OILS (At all Gulf Ports) Heavy Diesels	In Ship's Bunkers (Ex lighterage)
Below 2 API Grav.	$1.35
28 A IG v. & Above	$1.65
Bunker Oil..... $0.85–$1.27	$0.85–$1.27

Above products in Truck Transports of 2,400 gal. and over ½c above Tank Car Prices.

NOTE—Prices for heavy fuels vary within the range given above according to gravity from 9.9 grav. and below to 25 B and above.

Mid-Continent Lubes

(At Gulf; in packages, FAS.; in bulk, FOB terminals)

Prices in Effect Nov. 1

	Steel Drums	Bulk
200 Vis. D 210 brt. stock	35 (1)	28.8 (1)
150 vis. D 210 brt. stock 0-10 p.p.	31 (1)	24.8 (1)
10-25 p.p.	....	....
100 vis. D 210 brt. stock 0-10 p.p.	....	....
10-25 p.p.	....	....
200 vis. No. 3 col. neutral: 0-10 p.p.	....	....

Wax

(Melting points are AMP, 3° higher than EMP. Prices are FOB refinery and do not include bag, freight or export differentials).

Prices In Effect Nov. 1

Crude Scale	New Orleans Export	N. Y. Domestic	N. Y. Export
124-6 Yellow	4.25(1)	....	4.25(1)
122-4 White	....	4.25(2)	4.25(2)
124-6 White	4.25(1)	4.25	4.25
Fully Refined:			
123-5	5.2(1)	5.2(2)	5.2(1)
125-7	5.2(1)	5.2(2)	5.2(1)
128-30	5.6(1)	5.6	5.6(1)
130-32	5.85(1)	5.85(2)	5.85(1)
133-5	6.15(1)	6.15	6.15(1)
135-7	6.4(1)	6.4(1)	6.4(1)

Naphtha

Prices In Effect Nov. 1

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Philadelphia dist.	11 (2)	10
Baltimore	10.5 (2)	9.5
Boston	11.5 (2)	10.5
Providence	11.5 (1)	10.5 (2)

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National Petroleum News

Established February, 1909

Published every Wednesday by
The National Petroleum Publishing Co.

WARREN C. PLATT, *Editor and Publisher*
A. E. KRAFT, *Treasurer*
V. B. GUTHRIE, *Associate and Technical Editor*
V. C. REPPETO, *Managing Editor*
WILLIAM W. WESTON, *News Editor*
Y. A. KOSKINEN, *Advertising Manager*

Member of
Audit Bureau of Circulation
and Associated Business
Papers, Inc.

Publication office: 1213 W. Third St., Cleveland 13, Ohio, U. S. A. Telephone, CHerry 7672. Cable Address PLATTOIL, Cleveland. Cable inquiries are answered by mail unless subscriber advances sufficient funds in American money to cover our cable cost.

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Subscription rate $5 per year in United States, Mexico and Pan-American Countries; $6.50 in Canada and Foreign Countries. Current copies 20 cents, except special issues; back copies more than two months old 30 cents per copy.

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ABOUT OIL PEOPLE

Mr. Robinson

Mr. Wirtz

J. French Robinson, Cleveland, president of the East Ohio Gas Co., has been elected vice-president of the American Gas Assn. He was chairman of the association's natural gas section in 1941-42. Mr. Robinson also serves on the Petroleum Industry War Council and with PAW's natural gas and gasoline division.

As geologist or engineer, Mr. Robinson has been connected with a number of companies, among them the Baltimore & Ohio Railroad Co., the People's Natural Gas Co., the Columbia Natural Gas Co., and the Hope Natural Gas Co.—all affiliated with New Jersey Standard.

New chairman of the association's natural gas section is **Ralph E. Wirtz,** Amarillo, Tex., president of Amarillo Gas Co. From 1917 until 1931 Mr. Wertz was vice-president of Producers and Refiners Corp., in charge of geology, drilling, production and pipelines in the Rocky Mountain and Mid-Continent area. Since 1931 he has been chief executive officer of a group of companies in West Texas and New Mexico, engaged in the production, transmission and distribution of natural gas.

° ° °

R. L. Kent, owner of the Kent Oil Co., Salina, Kans., is convalescing at his home after a 3-weeks' stay at the hospital. Mr. Kent is an active member of the Kansas Oil Men's Assn., formerly serving as president of that organization.

° ° °

L. T. Morrow, Detroit, has resigned as head of industrial sales for Socony-Vacuum Oil Co., Inc., in the White Star-Ohio Division, and reports he has not yet definitely mapped his future plans. His resignation was effective Oct. 1.

° ° °

Among those receiving 20-year service pins from Humble Oil & Refining Co. are **Samuel M. May,** supervisor of the cost division, and **A. B. Penny,** assistant publicity manager and associate editor of the *Lubricator*. Mr. Penny has taken over the active management of the sales-publicity department in the absence of **Capt. G. A. Mabry,** now on military leave of absence.

° ° °

R. A. Colliton, St. Louis, secretary-treasurer of petroleum section, National Assn. of Credit Men, who has been ill, was able to attend the afternoon session of the association's 19th annual conference at the Coronada hotel in his home town on Oct. 27. As head of the tank car exchange bureau which operates through N.A.C.M. Mr. Colliton has a wide acquaintance throughout the oil industry, and his many friends at the St. Louis conference wished him a speedy recovery.

° ° °

New president of the National Council of Y.M.C.A.s in America is **Howard A. Coffin,** general manager of the White Star division of Socony-Vacuum Oil Co. Mr. Coffin has been associated with the Y.M.C.A. movement for the last 45 years.

For Petroleum Engineers

Gustav Egloff, Chicago, Universal Oil Products Co. research director, picked up a new stanza to "The Engineer's Song" during a trip to New York City last week—a staza written for oil engineers. It should go quitet well when the oil gang gathers 'round for tea and crumpets:

Who twists the hydrocarbons
Into structures strange and queer?
Who looks at coal tar chemistry
With a most disdainful sneer?
Who revamps his whole technology
A dozen times a year?
It's the polymerizing, catalyzing
Petroleum Engineer!

A promotion has taken **F. H. Skehan** from the managership of the Esso Marketers, Virginia division, to the managership of the New York division. Mr. Skehan succeeds **D. M. Cox** who has been named manager of the tire, battery and accessory department of Esso Marketers in New York City. Mr. Skehan started with Jersey Standard in 1906, as a clerk in Newark, N. J. Mr. Cox also was first employed by the company as a clerk, in 1920 at Charlotte, N. C.

° ° °

T. F. Thompson, president, Worth Refining Co., Inc. returned to Chicago Oct. 25 with a broken foot, the result of an accident while pheasant hunting in Alexandria, S. D. Mr. Thompson was riding on the radiator of a moving car, searching for pheasants. When the car preceeding his stopped suddenly, his driver didn't notice in time and ran into it. Mr. Thompson's foot was caught between the two cars. He is now sporting the latest in casts on one foot besides two crutches but expects to be able to remove the cast in another 6 weeks.

° ° °

Society of Automotive Engineers is swinging into its 1943-44 program, and 7 local or regional sections of the society out of the 29 sections in the country are headed by oil men, according to the S. A. E. Journal.

Arthur B. Gardner, president, United Oil Co., Inc., Baltimore, is chairman of the Baltimore section, S. A. E. The other six oil men serving as sectional chairmen are: **Edward R. Barnard,** assistant director of research, Standard of Indiana, Chicago; **Donald S. Flynn,** assistant division manager, Ethyl Corp., Kansas City; **Dr. Alfred G. Cattaneo,** research engineer, Shell Development Co., chairman, North California section and **Wallace Linville,** chief automotive engineer, General Petroleum Corp. of Calif., chairman for southern California section; **D. T. Evans,** lubrication dept., Globe Oil & Refining Co., Wichita, Kans., Section, and **Wilson E. Davenport,** assistant division manager, Union Oil Co. of California, is chairman for the Northwest Section.

° ° °

R. L. Philippi, formerly in charge of advertising and public relations for Union Oil Co. of California, has resigned to open a San Francisco office for an advertising agency. **T. L. Stromberger,** who has been with the company for 13 years, has been appointed advertising manager. **Miss Margaret Corey** will be in charge of public relations.

° ° °

Lt. J. G. McKeon, formerly division credit manager for Shell Oil at Detroit, is now on a 10 days leave of absence from Army duty, and is visiting his family and friends in St. Louis.

° ° °

S. B. Crooks, superintendent of sales and traffic for natural gasoline and chemical divisions of Cities Service Oil Co. at Bartlesville, Okla., recently returned from a 10-day vacation trip to Detroit where he visited his daughter and son-in-law, Capt. and Mrs. R. D. Ewing, and his two-months old grandson. Capt. Ewing was with Oil Well Supply Co. before entering the Army.

° ° °

Edwin J. Freeman, Acme Petroleum Co., Chicago, is quite proud of his patriotic family. His son, Sgt. Bud Freeman is with a bombing squadron in the Army Air Corps and last reports were that he was in Africa. His son-in-law, Lt. Donald Roeber, is in the communications branch of the Army Air Corps, stationed in England.

What Do We Mean—

"Built First to Last"?

. . . on the base of our trade-mark, as you will notice, is our slogan: "Built First to Last." We are and always have been proud of this business creed because it exactly describes our manufacturing policy.

It means, of course, that our very first consideration is to create a product of great durability—a product that will LAST. The war years have tested the lasting qualities of our truck tanks and trailers as they had never been tested before. They have had to be driven farther, driven faster, driven more constantly than at any other time, yet—according to all reports we have received—they have stood up to every demand placed upon them.

Without exception, Farrell products *are* "Built First to Last"!

New Trailers Available

To provide needed transportation for petroleum products, we are building a limited number of trailers under W.P.B. authorization. Ask us for full details. It is desirable to do so as quickly as possible.

4 to 6 Thousand Gallons

FARRELL MFG. COMPANY

Joliet, Illinois

That Fellow on the Corner

Hey, you there—
come away from that job
and listen a little.

We want to say some nice
things about you.

Maybe your ears will burn,
but you've got it coming.

Remember the old days when they kidded the service station man about all those extra services he gave?

You don't hear any of those wisecracks today, do you?

People now realize that those same services may make months of difference in the life of their cars and tires.

They appreciate as never before that the service station man really sets the pace for modern customer service in America.

* * *

Probably no businessman in America has had so many things happen to him since the attack on Pearl Harbor.

Gasoline rationing has cut deep into his main source of revenue.

His helpers have gone to war, and new helpers are hard to get.

His tire business has faded, but his tire-service job has multiplied.

People who never worried much about checking tires, batteries or radiator water are now asking for these services almost every time they drive in—and he's doing the best he can.

He has helped organize car-sharing clubs.

When nationwide salvage came along, he took on a junkdealer's labor, but still kept his serviceman's smile.

There is no telling what may be expected of him next.

More power to the sturdy, spunky service station operator who by keeping his place open

—is helping war plant workers get to their jobs

—is helping the country's fewer doctors call on at least as many sick people as there were before

—is helping to keep trucks trucking

—is helping people make those precious coupons go further.

So here's a cheer for the man on the corner. . . . no matter what color cap he wears—no matter what company he represents, he is pumping these days for America.

Attention, America!

America's cars are wearing out too fast (over 100,000 a month). Save yours. . . . ***Keep your speedometer arrow*** on the Victory Side of 35. . . . ***Switch your tires*** regularly for even wear. . . . ***Recap in time*** (this saves 60% of your original rubber). . . . ***Share the ride*** . . . ***Guard your car's "innards"*** with fresh oil and grease for motor and chassis, at least every 60 days. ***Get regular check-ups*** on battery and plugs.

KEEP ON—Caring for Your Car for Your Country

OUR MAN on the Corner

Right now he's busy saving cars with his Bumper-to-Bumper change-over service for fall.

It keeps the "run" in cars.

It includes everything from checking plugs to engine lubrication with Pure Pennsylvania Tiolene and "giving the gun" to vital gears with fresh Purelube.

He'd appreciate your "making a date" ahead—midweek if you possibly can.

Be *sure* PURE **with Pure**

THE PURE OIL COMPANY, U.S.A.

TUNE IN H. V. KALTENBORN—MONDAY THROUGH FRIDAY, 7:45 P. M. EASTERN WAR TIME, N. B. C. STATIONS

This advertisement is being published by The Pure Oil Company in leading newspapers as a well-earned tribute to all service station men—"no matter what color caps they wear."

TECHNOLOGY DEPT.

NATIONAL PETROLEUM NEWS

Monthly Technical Section Devoted to

REFINERY MANAGEMENT and PETROLEUM CHEMICAL TECHNOLOGY

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DETROIT

Section Two

November 3, 1943

Safety Precautions in Plants Making New Oil Products

Special features of design, construction and operation are presented before Petroleum and Rubber Sections of 32nd National Safety Congress.

Butadiene, by C. E. Starr, Jr. R-521
Synthetic Rubber, by Glen D. Cross R-526
Styrene, by H. K. Eckert R-530
HF Alkylation, by Roy Benson R-532
Ventilating Problems, by Bernard Offen R-538

Improving Ignition Qualities Of High-Speed Diesel Fuels

Additives to improve cetane number studied among other means for maintaining quality under wartime refining conditions R-499

Valve Maintenance Program Saves Money and Metal

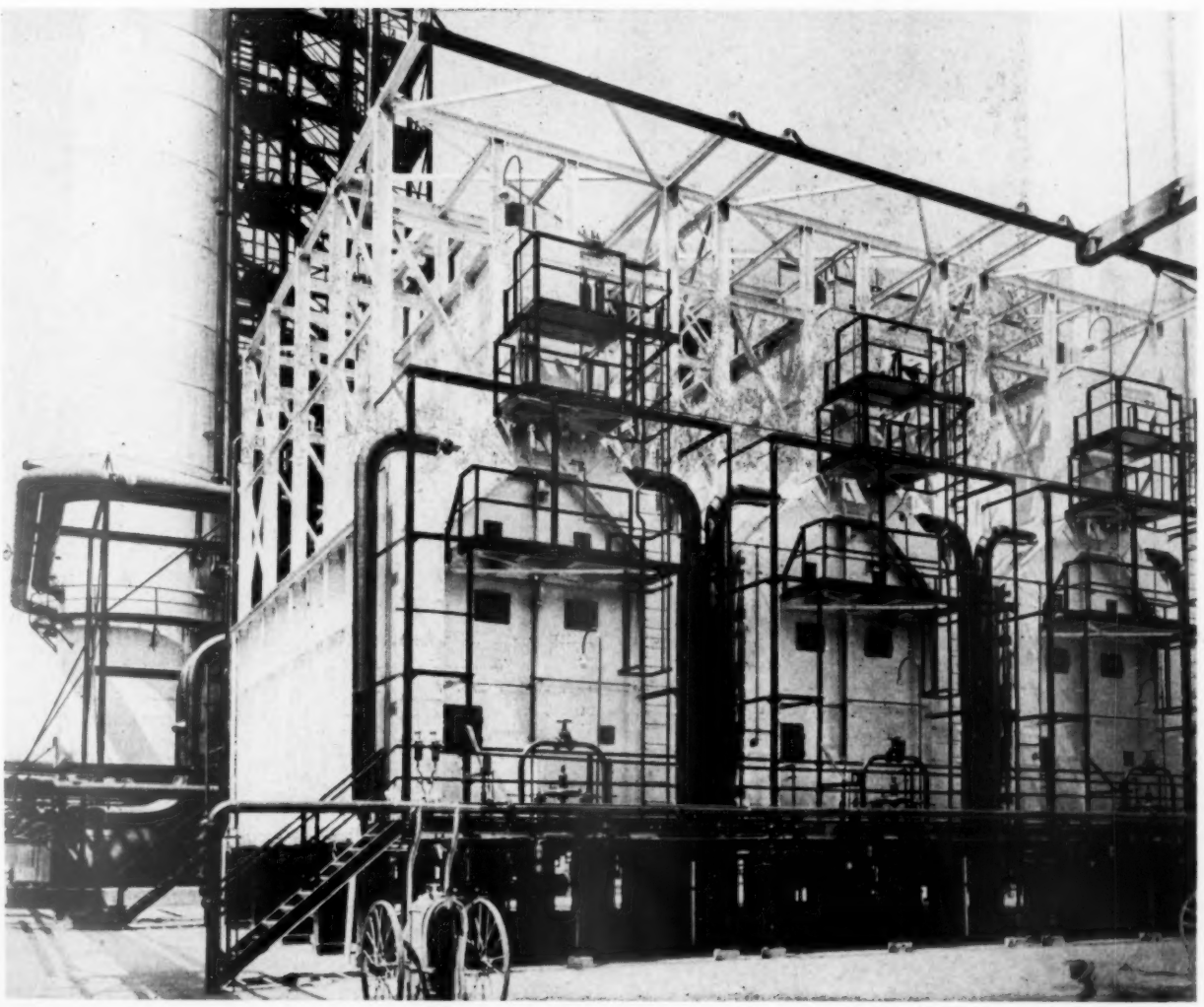
Regular inspection with shop repair work aids in the wartime conservation of this critical refinery equipment R-514

The Design of Foundations For Compressor Units

By Harry R. Marsh. Types are shown for different soil conditions encountered and methods of installation to reduce vibration R-544

Evaluation of Base Oils For Heavy-Duty Service

By A. O. Willey. Importance shown of full scale engine tests in determining oil and additive combinations for acceptable lubricant R-503



Three cell type furnaces form the heating unit for a 25,000-bbl. per day crude oil distillation plant at a modern refinery. Breeching connects the three heaters to the common stack. See article pg. R-518

Liaison Man for the Petroleum Technologists

R. P. Anderson

Official representative for the scientists of the oil companies in their contacts with other industries is R. P. Anderson, secretary of the Refining Division of the American Petroleum Institute. In addition to his duties in that position, he is secretary of Committee D-2 on Petroleum Products and Lubricants of the American Society for Testing Materials. There he and other petroleum chemists work with the chemists and engineers of other industries in preparing the specifications and tests for the petroleum products those industries use.

Also he is representative of the oil company engineers on various committees of the American Standards Assn. and other technical organizations in the work of preparing standards for the materials the oil industry uses. He serves for the oil companies with representatives of the Army and Navy and other government agencies on technical committees in Washington. Some years ago he was the official representative of this country in a program for the international standardization of petroleum testing methods. Not the least of his duties is directing the work of the Institute's Refining Division, which culminates in the committee work and meeting programs at the A.P.I. annual meetings.

Dr. Anderson studied at Cornell, received his Ph.D. in chemistry there in 1912. After teaching at Cornell for a few years, he took a job with the United Natural Gas Co. at Oil City. In 1924 he became the technologist of the A.P.I. staff and in 1931 was made secretary of the Refining Division.

REFINERY MANAGEMENT *and*
PETROLEUM CHEMICAL TECHNOLOGY

Nov. 3, 1943
Volume 35
Number 44

A MONTHLY TECHNICAL SECTION OF NATIONAL PETROLEUM NEWS *incorporating International Petroleum Technology*

ADDITIVES for DIESEL FUELS

266
754.2

Wartime Refining Conditions Give Impetus to Study of Use of Ignition Accelerating Compounds Among Other Means for Maintaining Quality of Fuels for High Speed Diesel Engines

THE REFINING INDUSTRY is today confronted with the problem of keeping up both the quality and quantity of its fuel for high-speed Diesel engines because of increasing demand for high octane aircraft fuels which requires the use of selected crudes and charging stocks as well as refining facilities for the production of aviation gasoline. If the trend continues, many refiners will be forced to consider new ways and means to improve the quality of the lower grade Diesel fuels.

Among the ways of accomplishing this are: (1) Use of additives or ignition accelerators, (2) blending low ignition-quality fuels with high ignition-quality fuels and then, if desirable, using an additive, and (3) use of solvent extraction to increase the paraffinicity of the fuel with, perhaps, use of additives. Use of some of these alternatives obviously would increase manufacturing cost. A number of research groups have been investigating, especially the first alternative, more or less continuously since the turn of the century. Their work to date yields an extensive list of Diesel fuel additive compounds on which patents have been issued.

The quality problem for Diesel fuels at present is made more pressing because of the increasing use of high speed Diesel engines in commercial transportation as well as military operations. Some engine manufacturers now specify a minimum of 50 cetane number for the desired degree of acceleration of ignition. Army requirements range from 45 to 50 minimum, depending on local climatic conditions.

Is 50 Cetane Necessary?

On the other hand, one authority in the oil industry is of the opinion, from a survey of the cetane number requirements for Diesel engines, that a 40 cetane fuel is satisfactory for most of the present day Diesels and that 45 will take care of most of the remainder; even though fuels marketed by many of the oil companies have been 50 cetane number or higher. An authority for the Caterpillar Tractor Co. states that a minimum cetane number of 40 is generally considered desirable for its engines, although under appropriate climatic and operational conditions it may be lower.

In the combustion of fuel in a Diesel engine, if the fuel ignition delay period is long (low cetane number) a large portion of the fuel accumulates and then ignites at once, resulting in a too-rapid increase in combustion chamber pressure. This is reflected in engine performance as "knock" with consequent rough-running, overheating, and loss of efficiency. If the fuel ignition delay period is short (high cetane number), the fuel charge ignites almost immediately upon entry and burns progressively giving a less-rapid increase in combustion chamber pressure, a smooth supply of power during combustion, and development of relatively high thermal efficiency.

Desired Characteristics

A desirable Diesel fuel is composed for the most part of straight-chain hydrocarbons possessing low ignition temperatures. A desirable gasoline is composed of hydrocarbons having high ignition temperatures; unsaturates, aromatics, cycloparaffins, and highly branched paraffins. Thus it will be readily seen that use of straight-run distillates for cracking stock robs the Diesel fuel supply, as cracked distillates thus produced generally possess poor ignition quality in high-speed Diesel engines.

This situation was pointed out in a paper by Nygaard, Crandall and Berger[1] published in 1941 which stated: "As long as sufficient quantities of straight-run products can be diverted from cracking processes to meet the requirements of Diesel engines, there should be little difficulty in supplying fuels of adequate ignition quality, but if the supply of these products becomes inadequate, the situation would be altered. Even straight-run products originating from highly aromatic and/or naphthenic crudes do not meet the ignition-quality requirements of modern high-speed Diesel engines. If, therefore, the time should come when both gasoline and Diesel fuels must be derived from cracking operations, other means must be employed to provide Diesel fuels of adequate ignition quality."

This problem, foreseen more than two years ago, now is facing many refiners, according to Larson[2] who stated that if conversion of refinery yields to produce 100-octane gasoline continues at the intended rate prescribed by the Petroleum Administration for War, the ratio of gasoline to distillate fuel production would be 7 to 1 in 1945 against 3 to 1 at the beginning of the war. He cited two examples to show the effect of conversion to 100-octane gasoline production on refineries:

Refinery A (55,000 b/d capacity) originally was making 4000 b/d of kerosine (No. 1 fuel), 8000 b/d No. 2 fuel (50-cetane), and 1000 b/d of No. 4 fuel (40-cetane); after conversion it made 3000 b/d kerosine, 5000 b/d No. 2 (40-45 cetane) and *no* No. 4 fuel. Considering quantity of Nos. 2 and 4 fuels alone produced, without regard to the obviously lower cetane number of the fuels, this means a 4000 b/d loss of Diesel fuel. Refinery B, a 12,000 b/d plant, made 4000 b/d total of kerosine and distillates; after conversion none were made.

Considering the postwar situation, Larson said:

"Diesel fuels will be available, but in many geographic areas the tractor distillate types of fuel will have to be used with low cetanes (37-40) or cetane additive agents will be added to maintain the 50 cetane minimum, such as called for by the high-speed Diesel engine manufacturers."

New Patent on Additives

The most apparent solution to this problem confronting many refiners is the improvement of a Diesel fuel through the use of additives which will shorten the ignition delay period. A recent patent (No. 2,329,489—issued Sept. 14, 1943) covering the manufacture of a product designed to do this introduces

[1] Nygaard, E. M., Crandall, G. S., and Berger, H. G., Means of Improving Ignition Quality of Diesel Fuels, Journal of the Institute of Petroleum, 27, 214, pp. 348-368, October, 1941. [2] Larson, C. M., NPN June 2, 1943, p. 16.

one of the latest known additions to the field.

This patent was issued to Francis M. Seger and Edwin M. Nygaard (one of the authors of the paper mentioned above) and assigned to Socony-Vacuum Oil Co. It is the culmination of several years of investigation which has resulted in a number of patents on other additives.

The patent covers the manufacture of a non-volatile oil-soluble product obtained from the reaction of perchloromethylmercaptan ($Cl_3C.SCl$) with elementary sulfur. The product appears to be $(Cl_3C)_2S_3$, $(Cl_3C)_2S_4$ or a mixture thereof. The 6 claims of the patent cover its admixture with a Diesel fuel in amounts ranging from about 0.1% to about 5.0% as well as the method of preparation. The wording of the patent, given in part as follows, is unusual for documents of its type, reading much like a technical article:

Patent Claims

"This invention is based upon the discovery that Diesel fuels of improved ignition quality can be obtained by admixing with the fuel a minor proportion of the oil soluble product (or fraction thereof) obtained by the reaction of perchloromethylmercaptan ($Cl_3C.SCl$) with elementary sulfur.

"Perchloromethylmercaptan, as indicated by the formula above, is a chlorinated substituted sulfur chloride and can be prepared by the chlorination of carbon disulfide according to the method of Helfrich and Reid (Journ. Amer. Chem. Soc. 43, 591 (1921)). For example carbon disulfide containing about .4% by weight of iodine was chlorinated in the absence of direct sunlight at a temperature maintained below 25° C. until the volume of the reaction mixture had doubled. The crude product, which has been topped to remove carbon tetrachloride and sulfur dichloride contains perchloromethylmercaptan, with some sulfur monochloride. This crude product can be used in the preparation of the reaction products contemplated herein, although in the example cited a fractionated product was used.

"Perchloromethylmercaptan may be reacted with elementary sulfur in proportions of about 2.0 parts to about 6.0 parts of the former to one part of the latter. The reaction is best carried out at elevated temperatures of from about 145° to about 170° C. with the heated reaction mixture under a reflux condenser.

"The product may be fractionated and purified as hereinafter described or, if desired, after initial topping, it may be treated (as by water washing) to destroy traces of sulfur chloride, and further treated as by dilution with petroleum ether to precipitate elementary sulfur, and then blended with the fuel oil in the desired proportions."

Examples are then given in the text of the patent showing results in improvement in cetane number with the addition of small amounts of the perchloromethyl mercaptan compounds prepared under different procedures, as described in general above, to both straight-run and catalytically cracked No. 2 fuel oils.

Two Examples

In one example, the addition of 1% by weight of two compounds to a straight-run No. 2 fuel oil in each case resulted in an increase of 10.5 in cetane number from 55 to 65.5. The characteristics of this fuel oil were as follows: API gravity, 39.8; flash point (Pensky-Martens °F), 172; aniline point °F, 160.5; ASTM distillation range, 386-614° F; Diesel index, 63.9; cetane number, 55.

The addition of 1% by weight of the same two perchloromethylmercaptan compounds to a catalytically cracked No. 2 fuel oil resulted in increases of 3.6 and 4.7 respectively in cetane number. Characteristics of this catalytically cracked fuel oil were: API gravity, 25.2; flash point (Pensky-Martens °F.), 204; aniline point °F 96; ASTM distillation range °F, 429-616; Diesel index 24.2; octane number 25.

In another example, with modification of procedure in preparing the additive compound and treating it with methanol to improve the odor, the addition of 0.5% by weight of the compound (a sulfur reaction product) to a catalytically cracked No. 2 fuel oil improved the cetane number 7 points to 40; the addition of 2% resulted in an improvement of 12.5 to 45.5 cetane number. Characteristics of this fuel oil were: API gravity, 28.8; flash point (Pensky-Martens °F), 200; aniline point °F, 122; ASTM distillation range, °F, 431-629; Diesel index, 35.1, cetane number 33.

Commenting on the results in cetane number improvement in these examples, the patent reads: "It will be observed the non-volatile reaction products of perchloromethylmercaptan and elementary sulfur are effective to improve the ignition quality of typical Diesel fuels. It will be observed that the reaction products contemplated herein contain both sulfur and chlorine in substantial quantities, the sulfur content ranging from about 29% to about 38% and the chlorine content from about 51% to about 64%.

"The exact chemical composition of the product is uncertain, but the analysis indicates that it is more probably predominantly comprised of $(Cl_3C)_2S_3$ or $(Cl_3C)_2S_4$ or a mixture of these compounds."

Historical Approach to Problem

Perhaps the best of recent literature on improving ignition quality of Diesel fuels is the article of Nygaard, Crandall and Berger previously cited. The work discussed in this paper, despite the fact that it now is more than 2 years old, still is considered authoritative.

These investigators based their attack on the three alternatives previously mentioned which in turn depend on type of stocks available and type of fuels it is desired to prepare. The base material, they said, might consist of (1) straight-run stocks of adequate ignition quality (50 cetane or better); (2) straight-run or cracked stocks of slightly substandard ignition quality (40-49); and (3) cracked stocks of low ignition quality (as low as 25 cetane number).

The problems which follow are: (1) to prepare 50 cetane number fuels from substandard stocks requiring an improvement of not more than 10 cetane numbers; (2) to prepare 50 cetane number fuels from cracked low ignition-quality stocks requiring an improvement of up to 25 cetane numbers; and (3) to prepare premium fuels from stocks of good ignition-quality (50 cetane) requiring an improvement of from 10 to 15 cetane numbers.

The most practical solutions of the first and last problems were considered to be through the use of fuel additives. This was not considered possible, economically, in solving the second problem, for an improvement of 25 cetane numbers would require the addition of approximately 5% by weight of the best accelerators known—equivalent to raising the octane rating of a gasoline from 24.5 to 68.5. Instead, the practical solution for this second problem was considered to be through solvent refining to increase the paraffinicity, or a blending of the low ignition-quality fuel with a high ignition-quality product. The possibility presents itself of obtaining additional improvement with additives in combination with the blend or the solvent-extracted product.

Additives Listed

Table I, taken from these authors' work, is a compilation of the most effective ignition accelerators known at the time the paper was written, arranged in the order of their effectiveness at a concentration of 0.5% by weight in straight-run and cracked Diesel fuels. The column headed "$E_{0.5}$" represents the cetane number increase per lb. of accelerator per bbl. of fuel, i.e., the effectiveness of the additive. This is a calculated value, obtained by dividing the cetane-number increase by the concentration of the addition agent in lbs. per bbl. For example: "$E_{0.5}$" of amyl thionitrite (0.5% by weight) in a straight-run Diesel fuel of 52 clear cetane number is 7.53+ because the 0.5% by weight concentration of approximately 1.793 lb. per bbl. increased the cetane number by 13.5 to 65.5; and 13.5 divided by 1.793 gives approximately 7.53.

"E" Value Not Constant

The value of "E" can be used to determine the cost per barrel per cetane number increase, simply by dividing the cost of the additive per pound by this factor. It must be emphasized, however, that "E" is not a constant for a given additive. Instead, it varies with the concentration in a particular fuel and

also varies with the fuel. In general, the value of "E" is higher when the additive is used in low concentrations and in straight-run paraffinic fuels. In Table I it is given, whenever available, for several different concentrations, and, where given parenthetically, the value has been estimated from data at other concentrations.

An additive should have at least 5 other characteristics besides increasing the cetane number of a given fuel in order to be of practical significance, it is brought out. These are:

(1) It should be relatively stable in the presence of water and not soluble in it for it is common to store Diesel fuel over water.

(2) It should be sufficiently soluble in oil to permit concentrations as high as 5% by weight, and if desirable to market in the form of a concentrate in fuel oil, the solubility should be much higher.

(3) It should be stable in the fuel towards variations in storage temperature; formation of a sludge or sediment

Table 1—Relative Effectiveness of Various Ignition Accelerators

	Ignition Accelerator	Patent Information	Fuel	CN	$E_{0.5}$*	Cetane-number change at 0.5% by wt.
(1)	Amyl thionitrite	U.S. 2,169,186 (1939)	Straight-run	52	5.02	...
			Straight-run	52	7.53+	13.5+
			Cat. cracked	27	2.23	...
			Cat. cracked	27	1.67	...
(2)	tert.-Butyl thionitrite	U.S. 2,169,186	Straight-run	52	7.53	13.5
			Cat. cracked	27	2.51	...
(3)	Ethyl thionitrite	U.S. 2,169,186 (1939)	Straight-run	52	5.02	13.0
			Straight-run	52	7.25	...
			Cat. cracked	...	1.12	...
(4)	Chloropicrin	U.S. 2,200,260	Patent data	39	5.58	10.0
			Straight-run	52	...	...
			Cat. cracked	25	...	...
(5)	Amyl nitrite	U.S. 1,820,983 (1931)	Straight-run	54	(5.3)	(9.5)
			Straight-run	52	...	...
			Cat. cracked	27	...	...
(6)	Acetyl peroxide	U.S. 2,174,680 (1939)	Straight-run	42	5.02	9.0
			Straight-run	53	...	...
(7)	Amyl nitrate	U.S. 2,158,050 (1939)	Straight-run	56.5	(5.0)	(8.9)
		Fr. 821,211 (1937)	Straight-run	56.5	...	...
		Can. 384,497 (1939)	Straight-run	52	...	...
			Cat. cracked	27	...	...
			Cat. cracked	27	...	...
(8)	n-Butyl nitrate	Brit. 374,481	Straight-run	56.5	(4.88)	(8.75)
		Fr. 730,208	...	...	...	...
		U.S. 2,031,497	Cat. cracked	...	...	...
(9)	Ethyl nitrate	Brit. 352,350 (1930)	Straight-run	52	4.46	8.0
		Brit. 354,398 (1930)	...	...	...	...
		Fr. 564,899 (1931)	...	...	...	...
(10)	Tetralin peroxide	U.S. 2,011,297 (1935)	Patent data	42	4.46	8.0
		Ger. 651,771 (1937)	...	...	...	...
(11)	Sulfur	...	Straight-run	50.5	4.18	7.5
			Straight-run	42	3.07	...
			Straight-run	56	...	...
			Cat. cracked	30	5.58	...
			Thermal cracked	36	2.23	...
(12)	Diamyl disulfide	U.S. 2,177,719 (1939)	Straight-Run	50	4.18	7.5
			...	42	3.35	...
(13)	Tetranitromethane	U.S. 2,185,157 (1939)	Straight-run	42	3.9	7.0
			Cat. cracked	27	1.12	...
			Cat. cracked	23	1.39	...
(14)	isoAmyl mercaptan (sweetened)	U.S. 2,167,345 (1939)	Straight-run	...	3.8—	7.0—
		U.S. 2,184,440 (1939)	...	...	...	...
(15)	Diethyl tetrasulphide	U.S. 2,034,643 (1936)	Patent data	44	(3.7)	(6.6)
(16)	Nitrogen tetrasulfide	Fr. 764,721 (1934)	Straight-run	...	(3.7—)	(6.6—)
(17)	Nitroso triacetone amine	Brit. 405,658 (1934)	Straight-run	...	3.63	6.5
(18)	Ethyl nitrogen sulfide	...	...	...	3.35	6.0
(19)	Acetone peroxide	U.S. 2,107,059 (1938)	...	39	3.35	6.0
		Brit. 428,972 (1935)	...	67	...	...
		Ger. 617,492 (1935)	...	...	...	...
		Can. 355,519 (1936)	...	...	...	...
(20)	Ethyl diphenyl pentazdiene	U.S. 2,188,262 (1940)	Straight-run	...	3.35	6.0
(21)	Ethyl xanthic disulfide (xanthogen or bis (thionocarbethoxy) disulfide)	...	Straight-run	42	3.35	...
			Straight-run	42	2.51	6.0
			Thermal cracked	36	2.23	...
			Cat. cracked	30	1.18	...
(22)	Ethyl diphenyl triazene	U.S. 2,136,456 (1938)	...	...	3.07	5.5
(23)	Ethyl-di-p-tolyl pentazdiene	U.S. 2,188,262 (1940)	Straight-run	...	2.79	5.0
(24)	Di-p-tolyl triazene	U.S. 2,136,456 (1938)	Straight-run	...	2.79	5.0
(25)	Hydrogen persulfide +sulfur	U.S. 2,206,594 (1940)	Straight-run	...	2.79	5.0
(26)	Dibenzyl disulfide	...	Straight-run	...	2.51	4.5
(27)	Benzyl bromide 50 + ethyl nitrate 50	Brit. 404,682 (1934)	Gasoline	19.5	(2.5)	(4.5)
		Fr. 757,326 (1933)	...	...	...	...
(28)	Butyl thiamine	U.S. 2,218,447	Straight-run	...	(2.5—)	(4.5—)
(29)	Propionyl peroxide	U.S. 2,178,327 (1939)	...	34	2.3	4.1
(30)	o-Toluidine disulfide	U.S. 2,164,151 (1939)	Straight-run	42	2.23	4.0
(31)	Aniline disulfide	U.S. 2,164,151 (1939)	Straight-run	42	2.23	4.0
(32)	Phenyl-p-tolyl triazene	U.S. 2,136,456 (1938)	Straight-run	...	2.23	4.0
(33)	Penta-methylene-p-tolyl triazene	U.S. 2,136,456 (1938)	Straight-run	...	2.23	4.0
(34)	Di-p-tolyl tetrasulfide	U.S. 2,034,643 (1936)	...	44	(2.0)	(3.6)
(35)	Diisoamyl disulfide	...	Straight-run	...	(2.1—)	(3.6—)
(36)	Di-ethyl disulfide	...	Straight-run	...	1.95	3.5
(37)	Diphenyl triazene	U.S. 2,136,455 (1938)	Straight-run	...	1.95	3.5
(38)	Tetraethyl lead	...	Straight-run	...	—11.4	—21

* 0.5% by weight concentration equals approximately 1.793 lb. of additive.

would mean depreciation in the fuel's cetane value and possibility of fouling or clogging injection mechanism in the engine.

(4) Presence of the additive should not accelerate corrosion of the engine parts with which it comes in contact, neither should combustion products be corrosive.

(5) It should be non-toxic in the fuel and in products of combustion.

To these 5 might be added the most obvious characteristic of all; the additive should be inexpensive to make and economical to use in effective concentrations.

Effectiveness of Additives

Nygaard et al make these comments concerning effectiveness of the various additives listed in Table I:

"Of the various materials on which we have information, the most effective are the thionitrites. In straight-run fuels these materials give a cetane-number rise of 10 to more than 13.5 at 0.5% concentration. These materials are prepared from the interaction of mercaptans and nitrous acid or its derivatives.

"Chloropicrin gives an increase of approximately 10 cetane numbers at 0.5% concentration. This material is also used as an emetic war gas, so that its use in fuel might present some difficulties.

"Alkyl nitrates and nitrites have been known for some time as effective addition agents for Diesel fuels. Amyl nitrite and amyl nitrate were the most effective of those tested. These gave an ignition-quality improvement of approximately 9 cetane numbers at 0.5% concentration. Ethyl and butyl nitrates were somewhat less effective.

Careful Handling Needed

"Peroxides have about the same effect on ignition quality of Diesel fuels as the alkyl nitrites and nitrates. The most effective ones are acetyl peroxide, tetralin peroxide, acetone peroxide, and propionyl peroxide. These materials are hazardous to prepare and handle in the free state, but some may be prepared directly in the fuel, in which case the blends are comparatively stable. Fuels containing acetyl peroxide, although stable in the absence of water, rapidly hydrolyze when stored over water.

"Tetranitromethane improved the ignition qualities of straight-run fuels by 7 cetane numbers. This is then somewhat less effective than trichloronitromethane (chloropicrin).

"Another type of compound that shows considerable effectiveness in improving the ignition quality of Diesel fuels is the aryldiazo-derivatives of amines. The effectiveness of these compounds seems to parallel their instability. The quite stable triazines (diazo-amino-compounds) which are formed from the condensation of a diazonium halide with an amine have a moderate effectiveness (about 1.9-3.1) as ignition accelerators. The pentazdienes (bisdiazoamino-compounds), which are more unstable and hazardous to handle in the pure state, range in effectiveness from about 2.8 to 3.4.

"An inexpensive and fairly effective ignition accelerator is elementary sulfur. This has an effectiveness of 4.18 at 0.5% (cetane-number improvement = 7.5). It was found to be particularly effective in catalytically cracked fuels. Its practical use is hampered by (1) fuel specifications limiting total sulfur content of fuels, (2) relatively low solubility in the fuels, and (3) possible corrosive action of it or its combustion products on engine parts.

"A relatively broad class of fairly effective ignition accelerators consists of compounds containing nitrogen and sulfur linked together. The thionitrites (R-SNO) are members of this class which have already been mentioned. Others in order of effectiveness are: (1) dialkylamine disulfides (R_2N-S-S-NR_2), (2) nitrogen sulfide (N_4S_4), (3) alkyl nitrogen sulfides (RN_2S_2), (4) thiamines ($(RNS)_4$). The amine disulfides and thiamines are readily prepared by the action of chlorides of sulfur on secondary and primary amines. Nitrogen sulfur is a somewhat explosive material having low solubility in fuels; the alkyl derivatives are made from it.

"In general, the organic di- and polysulfides improve the ignition quality of Diesel fuels. The most effective types tested were those prepared from mercaptans by sweetening in presence of sulfur. Other effective materials are hydrocarbon tetrasulfides, xanthic disulfides, hydrogen persulfides, dibenzyl disulfide, alkyl disulfides, and aminoaryl disulfides.

"Other materials which have an effectiveness of more than 2.5 at 0.5% concentration—i.e., gave more than a 3.5-cetane-number increase—are nitrosotriacetone amine, and a combination of ethyl nitrate and benzyl bromide."

These authorities state that solvent refining of Diesel fuels will result in an increased cetane number as might be expected of any treatment designed to increase the paraffinicity of a stock. Investigations have shown that methods successful in treating lubricating oils operate in a parallel fashion on Diesel fuels. Another successful treatment, besides that of solvents, is with aluminum chloride.

An equation has been developed for the comparison of effectiveness in producing higher cetane numbers through various processes of solvent treatment and with use of additives which may be expressed as

$$E_t = \frac{\%\ \text{yield (by volume)}}{100} \times (\text{C. N. of raffinate} - \text{C. N. of base fuel})$$

Cost per barrel per cetane number increase is

$$\frac{\text{Treating cost per bbl.}}{E_t}$$

In Table 2 are shown the effect of various solvent treatments on straight-run and catalytically cracked fuels. It will be noted that in the case of straight-run fuel stocks from Mid-Continent crudes, ethyl alcohol, acetone and phenol extractions result in least cetane-number improvement, while treatment with aluminum chloride or with sulfur and extraction with furfural results in the greatest improvement; for cracked stock, sulfur dioxide extraction is the only treatment on which the authors provide data.

The authors conclude that where large increases in ignition quality are required, the most economical solution appears to be solvent treating, or a combination of solvent treating with use of small quantities of an additive to the treated stock. This is because raising a 25 cetane number cracked stock to 50 cetane would require for example, 5% addition of amyl nitrate (effectiveness at 5% is 1.25) which would cost (at price of 10c per lb. for additive) $2 per bbl. for the improvement. Use of sulfur dioxide extraction, on the other hand, (assuming an effectiveness of 13.3 from Table 2, No. 12, and treating cost of 67.5c per bbl.) would be $1.28 per bbl. for the improvement.

Table 2—Effect of Solvent Treating on Diesel Fuels

No.	Type fuel treated	Treating agent	Cetane number Original	Cetane number After Treatment	Cetane number Change	Yield %	Et
		A. Straight-run Stocks					
1	Mid-Continent ...	Aluminum chloride	50.5	58.0	7.5	78	5.95
2	Mid-Continent ...	Ethyl alcohol extraction...	50.5	54.5	4.0	78	3.12
3	Mid-Continent ...	Sulfur (heat at 100°C)	50.5	58.5	8.0	100	8.0
4	Mid-Continent ...	Furfural extraction	51.5	60.0	8.5	76	6.45
5	Mid-Continent ...	Furfural extraction	51.5	63.5	12.0	46	5.40
6	Mid-Continent ...	Acetone extraction	51.5	58.5	7.0	56	3.92
7	Mid-Continent ...	Phenol extraction	52.5	56.0	3.5	77	2.69
8	Mid-Continent ...	Phenol extraction	52.5	58.5	6.0	62	3.72
9	Zistersdorf	Sulfur dioxide extraction ..	49	62.5	13.5	78.7	10.6
10	Zistersdorf	Sulfur dioxide extraction ..	49	62.5	13.5	73	9.85
11	Zistersdorf	Sulfur dioxide extraction ..	49	65.5	16.5	54.4	9.02
		B. Cracked Stocks					
12	Zistersdorf catalytically cracked ...	Sulfur dioxide extraction ..	34.0	59.0	25.0	53.4	13.3
13	Zistersdorf catalytically cracked ...	Sulfur dioxide extraction ..	34.0	65.5	31.5	44.6	14.0

BASE OIL EVALUATION FOR HEAVY-DUTY SERVICE*

By A. O. Willey**

The presentation of data on the subject of heavy-duty lubricants is of special interest at this time, when so much of the attention of the petroleum industry is centered on meeting the needs of our armed forces in all their world-wide operations. The paper emphasizes that:

Full-scale engine tests have proved to be the only dependable means of evaluating base oil stocks for heavy-duty service.

Source of crude, method of refining, or use of additive compounds are no guarantee of acceptability.

An inferior base oil cannot be transformed into an acceptable heavy-duty oil merely by the use of an additive.

Not all base oils are equally susceptible to improvement with a given additive. Not all additives are equally effective in the same base oil.

Investigation of base oil and additive combinations by full scale engine tests is essential to the development of an acceptable heavy-duty oil.

TODAY'S requirements for a heavy-duty motor oil present the oil industry with the problem of developing a single product that will do an equally good job in a one-half horse power, 56-in. boost aviation engine; as well as handle several types of hydraulic transfer units, heavy duty transmissions, and Diesel engine applications in between. In the popular conception, it should also compensate for "ersatz" materials in the equipment it lubricates, correct all mechanical distortion irregularities, serve as a rust preventive compound, not foam at 40,000 feet altitude, and provide good lubrication at 70° F. below zero.

Through an extensive process of evolution, aided by some rather satisfactory experience in pre-war commercial applications, there has been developed—for the present at least—a fairly satisfactory answer to the above requirements. This has been achieved by blending small percentages of certain chemical compounds with good grade base oils of suitable susceptibility characteristics.

At first glance, this procedure appears to contradict the entire theory of oil production, refining and lubrication technique. Such a program seems inconsistent, illogical, and unsound when considered in terms of acceptable technical and engineering practice.

To begin with, the oil refiner takes a given crude and puts it through various stages of distillation, acid treating, filtration and even extraction, at considerable expense in equipment, processing and yield. In so doing, he changes a few items of physical inspection data and at the same time probably removes a substantial portion of the natural solvency, oiliness, and inhibitor characteristics.

He then reverses this subtraction process by compounding the oil with addition agents, in the form of synthetic materials designed to impart these same characteristics which were removed during the refining program. In fact, some very interesting work has been done involving the return of fractions of the initially extracted components to the finished oil.

Another inconsistency in this picture is the age-old controversy regarding relative merits of paraffinic versus naphthenic materials. Today we are taking the naphthenic stocks and, by use of special refining methods and selected additive ingredients, trying to make them conform to certain characteristics of the more paraffinic products. Conversely, we are working just as actively on the paraffinic materials to accentuate certain properties common to the naphthenic base oils.

Obviously, this is a vicious cycle. But if we are to meet the inclusive requirements of the so-called all purpose, heavy-duty oil, without serious limitation as to sources of base stocks and distribution facilities, some such program must be adopted. In following this subject through to a logical conclusion, in terms of today's knowledge and developments, certain old ideas must be discarded or at least viewed with a very considerable degree of broad-mindedness.

First, the type of crude from which an oil is derived is not in itself indicative of the suitability of the product as

*Presented before National Petroleum Assn., New York, Sept. 21, 1943.

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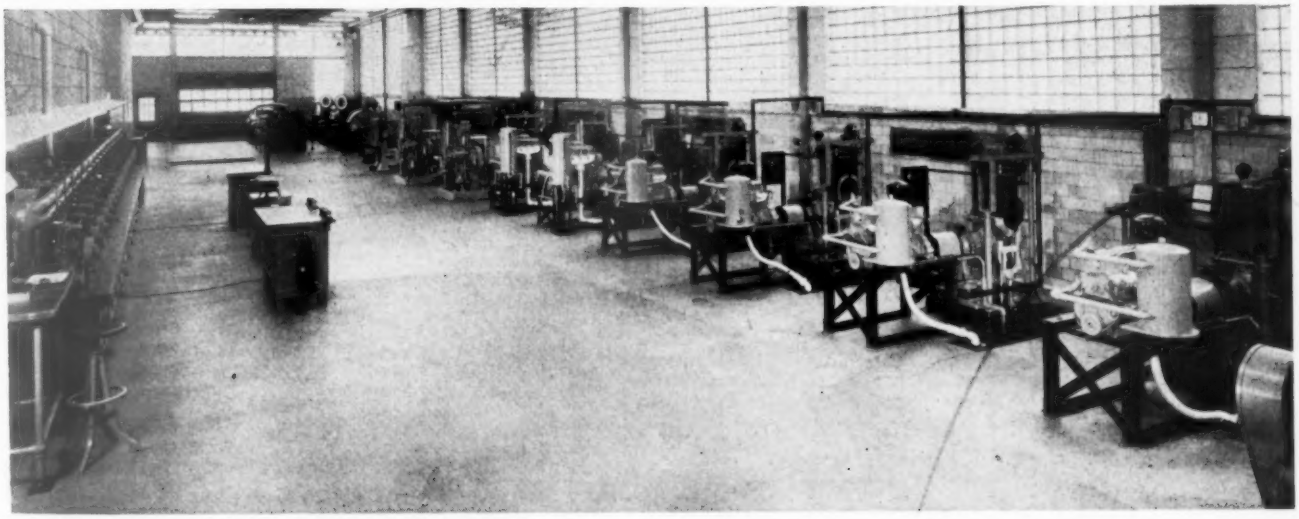


Fig. 1—Modern engine testing laboratory of Lubri-Zol Corp., showing various engines used in testing heavy-duty oils. In right foreground are standard 1942 model Chevrolet passenger car engines, and back of them General Motors Model 4-71 Diesel engines, and in right background are Caterpillar Diesel engines. On the left side is the bank of single-cylinder Lauson engines used in pre-evaluation tests

a base stock for today's heavy duty lubricants. As an illustration, properties of a group of three base oils of widely varying types, all of which have been successfully used in qualified heavy-duty lubricants, are shown in Table 1.

Second, the more or less standardized forms of inspection data common to the industry for the past many years no longer serve as criteria of the service performance of a product. Many people have been inclined to feel that the only things important in selecting a motor oil are the brand name of the marketer, the color of the can, and the SAE grade. While the first continues to be of importance, both the other items now are of slight significance. We can't even get the cans in the first place and SAE grades have been so effectively confused as to make them relatively meaningless.

The data given in Table 2 illustrate the inadequacy of inspection data as a means of specifying the more important

Table 2—Specifications and Service Properties of Motor Oils

Inspection Data	Service Properties
Flash	Oxidation
Fire	Corrosion
Gravity	Film Strength
Carbon Residue	Wear Rate
Viscosity	Oiliness
Viscosity Index	Demulsibility
Pour Point	Detergency
Neutralization Number	Ring Strength
Color	Varnish Formation

functions that today's lubricants are called on to perform. None of us would attempt to use the values shown by the tests listed in the left column as a basis for predicting the service properties shown in the column on the right.

This brings up the question as to how we are to know when we have succeeded in producing the multi-purpose product required today without first ruining the equipment in which it is used, and then attempting to collect our information from an autopsy of the remains. Even if the conventional specification data did previously indicate the properties of an oil, it must be admitted that today's practices in refining and compounding have greatly changed the characteristics of the product.

The old time inspection data which the industry has used these many years have outgrown their usefulness in the evaluation of lubricants for heavy-duty service.

The next item that must be conceded is that bench tests no longer provide sufficient information from which to evaluate the service performance of heavy-duty lubricants.

Although most of us have our own individual versions of short-cut methods and pre-evaluation tests, dictated in many instances by economics of time, equipment and personnel, I believe we all will agree that in the final analysis it is necessary thoroughly to investigate any given product under a wide variety of conditions on full-scale equipment.

This naturally leads to consideration of the more or less accepted standard of today, the Ordnance Department 2-104B Specification (See Table 3*). It is a well known fact that this specification was derived from the experience of industry over a period of several years prior to the war. It is also no military secret to state that in ground force service today—which is unquestionably the most diversified and largest scale field test of lubricants that the world has ever known—oils meeting this 2-104B specification are standing up in severe service and doing an excellent job.

Table 1—Typical Inspection Data for Three Heavy-Duty Oils

Type of Oil S.A.E. 30	Naphthenic	Mid-Cont.	Penna.
Gravity	19.8	28.4	30.3
Viscosity Index	55	85	108
Fire Point	425	455	475
Conradson Carbon	.26	.32	.70
Cold Test	—20	—10	—10

In view of the importance of this specification in evaluating oils for heavy-duty service, it would seem in order to discuss briefly the scope of the program involved in obtaining an Ordnance Qualification Number for 2-104B specification oil.

The test equipment required is extensive and more or less specialized.

Fig. 1 shows our own test laboratory, which is by no means one of the largest, but nevertheless will serve to illustrate the type of full-scale engine testing called for in the specification.

The caterpillar single cylinder engine used for the L-1 and L-2 tests is shown in Fig. 2. The L-1 test is the 500-hour run for investigation of ring sticking, top

*Appendix 3 from "Fuels and Lubricants for U. S. Army Motorized Ground Forces," by George A. Round; Technical Section, NATIONAL PETROLEUM NEWS, July 7, 1943, p. R-300.

Table 3—Oil, Engine

U. S. Army Specification No. 2-104B
Revision May 6, 1943
(Condensed)

B. GRADES.

B-1. Engine oil shall be of three viscosity grades designated as SAE 10, SAE 30 and SAE 50.

C. MATERIAL AND WORKMANSHIP.

C-1. Engine oil shall be a refined petroleum product with or without additive agents.

D. GENERAL REQUIREMENTS.

D-1. Engine oil shall be non-corrosive to bearings and engine parts, shall not cause or permit piston ring sticking or clogging of oil channels and shall minimize cylinder and ring wear. This engine oil shall provide satisfactory lubrication of high speed, automotive type gasoline, Diesel, or spark ignition fuel engines when operated under all conditions of service. Additive agents, if used, shall not appreciably increase the tendency of the base oil to foam.

D-2. Additive agents if used, shall remain uniformly distributed throughout the oil at all temperatures above the pour point up to 250° F. If the oil is cooled below its pour point, it shall regain its homogeneity on standing at a temperature of not more than 10° F. above the pour point of the oil.

E. DETAIL REQUIREMENTS.

E-1. **Qualification.** Engine oils furnished under this specification shall be of a grade or grades which have been tested and found suitable for the purpose intended as determined by the "Qualification" tests in section F (see paragraph H-1).

E-2. Engine oils covered by this specification shall be in accordance with Table I.

TABLE I

Test	Test Limits Grade SAE 10	Grade SAE 30	Grade SAE 50
Viscosity, Saybolt universal			
Seconds at 130° F.	90 to less than 120	185 to less than 255	
Seconds at 210° F.			95 to less than 105
Viscosity Index, minimum	85	55	75
Pour Point, °F., maximum	minus 10	0	15
Pour Point after dilution with 20 per cent precipitation Naphtha, °F., maximum	minus 40	minus 40	
Flash Point, °F., minimum	360	390	400

E-3. **Flash Point.** The minimum flash point of Grade SAE 50 before the addition of any additive shall be 450° F.

E-4. **Control Limits.** For purposes of product identification, the bidder shall state in his bid the suitable control limits of the oil he proposes to furnish, as regards the following:

Gravity, API
Carbon Residue, per cent
Sulphur, per cent
Phosphorous, per cent
Chlorine, per cent
Ash, per cent
Components of Ash, per cent, and such other tests as he may consider desirable for identification purposes.

F. METHODS OF SAMPLING, INSPECTION AND TESTS.

F-3. **Qualification tests.** All engine oil procured under this specification shall be tested for qualification as follows:

F-3a. Unless otherwise specified, the qualification tests shall be made in accordance with Table III (see paragraph H-1):

TABLE III

Required when the finished engine oil uses an additive not previously used in an Engine Oil qualified by the Ordnance Department.	Required when the finished engine oil uses an additive previously used in an Engine Oil qualified by the Ordnance Department.
SAE 10 Grade	**SAE 10 Grade**
1. CRC-Designation-L-4-243	1. CRC-Designation-L-4-243
2. CRC-Designation-L-1-243	2. CRC-Designation-L-1-243
3. CRC-Designation-L-2-243	3. CRC-Designation-L-2-243
4. CRC-Designation-L-3-243	
SAE 30 Grade	**SAE 30 Grade**
1. CRC-Designation-L-5-243	1. CRC-Designation-L-4-243
2. CRC-Designation-L-4-243	2. CRC-Designation-L-1-243
3. CRC-Designation-L-1-243	3. CRC-Designation-L-2-243
4. CRC-Designation-L-2-243	
5. CRC-Designation-L-3-243	
SAE 50 Grade	**SAE 50 Grade**
1. CRC-Designation-L-4-243	1. CRC-Designation-L-4-243

NOTE: CRC Designation L-4-243 is essentially the 36-hour Chevrolet engine test. CRC Designation L-1-243 is essentially the 480-hour single cylinder Caterpillar Diesel engine endurance test. CRC Designation L-2-243 is essentially the single cylinder Caterpillar Diesel engine "Scratch" test. CRC Designation L-3-243 is essentially the 4 cylinder Caterpillar Diesel 120-hour stability and bearing corrosion test. CRC Designation L-5 is essentially the GMC Diesel 500-hour test.

To meet the urgent and rapidly expanding military demands for aviation gasoline, toluene and aviation lubes, the petroleum industry was faced with the necessity of breaking many bottlenecks in established processes and manufacturing facilities.

Drawing upon a fund of engineering experience extending back to the beginning of modern oil refining, Kellogg has played a major role in breaking bottlenecks in the production of these vital war materials.

DESIGN, CONSTRUCTION and LICENSING

CATALYTIC PROCESSES for Cracking, Hydroforming, Reforming, Dehydrogenation, Alkylation, Desulphurization
GASOLINE PRODUCTS COMPANY, INC....Pyrolytic Cracking • THE POLYMERIZATION PROCESS CORPORATION...Thermal and Catalytic Polymerization
DUBK Processes ... for Lubricating Oil Refining with Propane and Phenol • Deasphalting • Dewaxing • Solvent Extraction and Acid Treating Plants

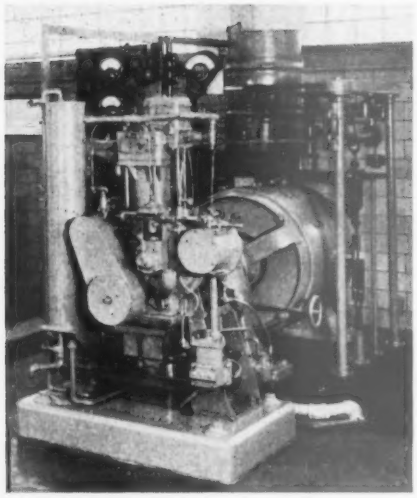


Fig. 2—Caterpillar single cylinder laboratory test engine used in L-1 and L-2 tests. The engine, 5¾-in. bore by 8-in. stroke develops 20 h.p. at 1000 r.p.m. The L-1 test is run for 500 hours, with an oil change every 120 hours

crown cutting, carbon formation, and general cleanliness or detergency conditions. The L-2 test, more commonly known as the "scratch test" is used as a measure of the film strength of the lubricant.

Various Types of Engines Used

The Caterpillar four-cylinder engine used for the 120-hour L-3 test is shown in Fig. 3. This test is required only when qualifying a new additive and, whereas it is considered to be a means of checking many of the same properties as the L-1 test, it also provides a measurement of bearing corrosion, since the engine used is equipped with copper lead bearings and operates at a relatively high crankcase oil temperature.

Fig. 4 shows a Chevrolet engine used for the L-4 test. This test has come to be used as a measure of the high temperature stability of an oil with considerable emphasis on the copper-lead bearing corrosion feature.

A typical General Motors Model 4-71 Diesel engine installation used for the L-5 test is shown in Fig. 5. This test is also in the same category as the L-3 test, being required only when an oil using a previously unqualified additive compound is involved.

In mentioning these tests it should be pointed out that the kind of engine used, whether Caterpillar, Chevrolet, or General Motors Diesel, is only incidental. In each case the engine and test procedure are selected as a means of checking a certain specific quality of the oil. For instance, experience has shown that one combination of engine and test procedure evaluates varnish forming tendencies, while another kind of engine, run on a different test procedure, shows practically nothing about varnish but gives positive indications as to ring sticking and engine cleanliness. Consequently, it is necessary to run several types of tests and accumulate the results on a broad basis before attempting to qualify a product in terms of its all-round service characteristics.

Table 4—Lauson Engine Test Results on Various Base Oils

Type of Oil SAE 30	NAPHTHENIC Solv. Ext.	NAPHTHENIC Solv. Ext.	MID-CONTINENT Solv. Ext.	MID-CONTINENT Solv. Ext.	PENNSYLVANIA Solv. Ext.	PENNSYLVANIA Solv. Ext.
Viscosity Index	43	55	94	95	110	111
ENGINE INSPECTION						
Piston Rating	B	C	B	C	B	B
Rings Stuck	0	0	0	0	0	0
Oil Ring Filling, %	0	0	10	0	10	0
Bearing Loss in Wt., mgs.	44	96	32	44	56	59
DRAIN ANALYSES						
Conradson Carbon, %	1.80	1.00	1.54	3.12	1.37	2.35
Naphtha Insol., %	.00	.00	.03	.10	.06	.11
Neutralization No.	.55	.18	.80	1.47	.97	1.05

Duration of all tests—240 hours. Analyses at 240 hours. Jacket temp. 345° F. Oil temp. 225° F.

Reference was made earlier to preevaluation tests. We choose to call these "go" and "no go" tests and use a small single-cylinder Lauson engine for the purpose. A bank of these engines is shown in Fig. 6. The specific details of test procedures used on these engines will be omitted, but it should be emphasized that when interpreted in a broad sense, results of these small scale engine tests are extremely valuable in the early stages of evaluation of oils. To date, we have made over 9700 such tests and this wide experience and background has come to mean a great deal in the interpretation of any one individual result.

Results of a series of Lauson engine tests on base stocks ranging from 40 to 111 Viscosity Index, all compounded with the same additive, are given in Table 4. It will be noted that no one particular type of base oil shows outstanding superiority when all factors of piston condition, ring sticking, sludging, bearing corrosion, and drain oil conditions are considered.

The next table, Table 5, shows a similar comparison for the Chevrolet (L-4) test. Here, again, it would be difficult to justify a preference as to type of base oil, although, as might be expected, certain individual combinations do show outstanding properties.

Results of Caterpillar tests do not readily lend themselves to numerical presentation. However, the differences between satisfactory and unsatisfactory results are easily discernible in terms of ring sticking, top crown cutting, ring belt area deposits, and general cleanliness.

Tests Not Always Conclusive

Interpretation of the Caterpillar L-1 tests is in most cases well defined—any tendency toward ring sticking or excessive carbon and lacquer deposits being

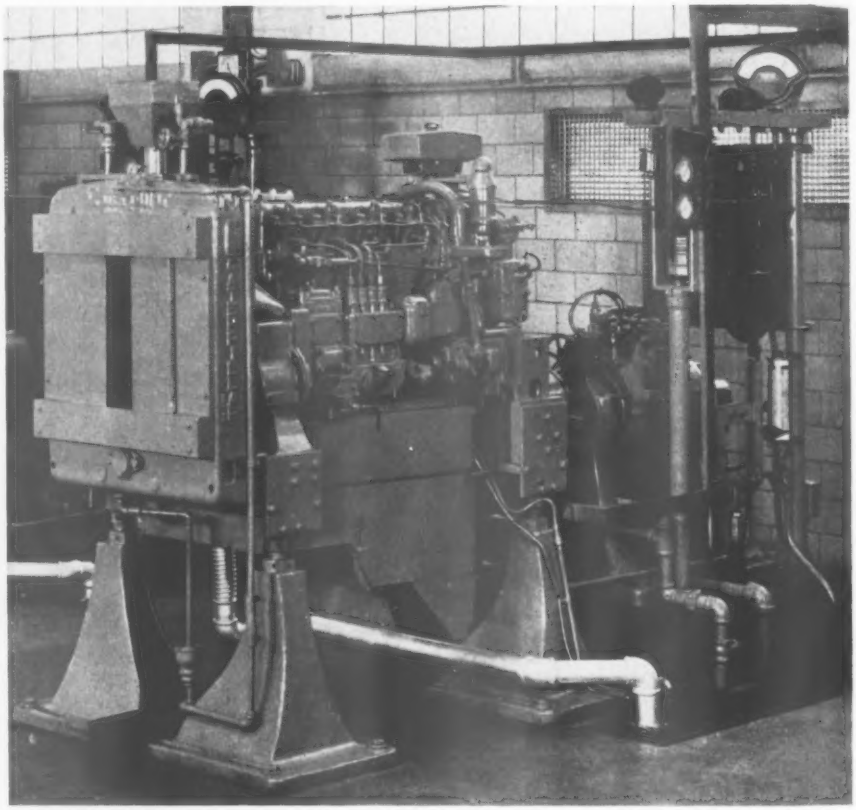


Fig. 3—The Caterpillar 4-cylinder diesel test engine used for the L-3 test. Bore is 4¼-in. and stroke 5½ in. The engine develops 37 hp. at 1400 r.p.m. The L-3 test is run for 120 hours with no oil change

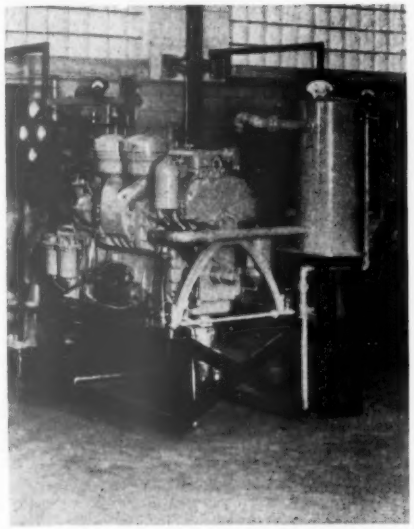


Fig. 5—The General Motors Model 4-71 Diesel engine used for the L-5 test, which is run for 500 hours with no oil change. The 4-cylinder engine develops 106 h.p. at 2000 r.p.m.

considered as evidence of unsatisfactory service performance of the product. It is only when a borderline condition exists that it becomes difficult to evaluate an oil in terms of the characteristics measured by this test. In such cases, it is the practice to consider the overall results of all tests and arrive at conclusions based upon the general performance of the lubricant, giving proper weight to relative values of each. Although experience with the L-1 test has made it possible to develop some theories as to the inherent characteristics of various general types of base stocks, it is still not safe to attempt to predict as to whether or not an oil will satisfactorily meet all the requirements of this test.

The L-2 test has been the subject of theories as to the effect on results of types of crude, methods of refining, and even SAE grades; but in the final analysis it has been found necessary actually to run the test in order to find out whether or not an oil meets its requirements. Even today one would hesitate to state that a paraffinic material would be more likely to pass this test than a naphthenic product and certainly the reverse could not be predicted with any degree of assurance.

It would hardly be justifiable not to include the L-5, 500-hour General Motors Diesel test in this discussion. There has been a considerable amount of conjecture concerning the relative merits of the naphthenic, Mid-Continent and paraffinic oils in overcoming tendencies toward port clogging and bearing corrosion on this test. Here, again, excellent results have been obtained with all three types of materials and no offhand preference could be shown other than that exhibited by the actual test results. Table 6 gives a summary of L-5 test results from three widely different stocks, all treated with equivalent amounts of the same additive.

When it comes to being more specific as to the oils in which the refiners of Pennsylvania crude are primarily interested, it must be admitted that we have only limited data available for presentation. This is partly due to a policy of not releasing information on identified products whether treated with our own or with other additives. However, through the cooperation of several members of the National Petroleum Assn., we have been given permission to show results of a few tests using base oils with which many are undoubtedly familiar. Table 7 shows L-4 results on Franklin Creek Refining Co.'s SAE 10 oil which has been qualified under Ordnance Specification 2-104B.

Table 7—Results on Franklin Creek SAE 10 Oil on Chevrolet 36-Hour Test

Engine Deposit Rating	82
Bearing Loss in Wt., ave. ½ bearing, gms.	.131
DRAIN ANALYSES	
Conradson Carbon, %	1.48
Naphtha Insol., %	.69
Chloroform Sol., %	.28
Viscosity Increase, %	26.2
Neutralization No.	1.77

For purposes of comparison these results have been tabulated in Table 8 along with a wide range of other base oils in the SAE 10 grade, all compounded with the same additive. It will be noted that this oil shows equally good results with respect to engine cleanliness and resistance to bearing corrosion and some superiority with respect to oil stability as indicated by the drain analyses. This same product passed the L-2 test, run as required for the 2-104B Specification, at Armour Research Foundation.

The inspection summary for the L-1 test showed: No ring sticking, medium top crown cutting, light deposit behind the rings, piston skirt, ring sides and ring lands clean. These inspection data indicate better than average results for all items except top crown cutting and rather normal characteristics in this respect. There was no question as to the acceptance of this product as an approved heavy-duty oil.

Some strictly preliminary work has been done on United Refining Co.'s SAE 30 base oil, consisting of a blend of conventionally refined 150 at 70° Pennsylvania neutral, 2½ color, and a conventionally refined bright stock of No. 1 Tag Robinson color, 25° F. pour point and 1.65% Conradson carbon. A qualified 2-104B additive has been used with this base oil.

In a pre-evaluation Lauson engine test the untreated oil was run for 90 hours, at which time the test was discontinued due to poor detergency and excessive sludging tendencies as shown by the discoloration of the piston and the

Table 5—Chevrolet 36-Hour Engine Test Results on Various Base Oils

	NAPHTHENIC		MID-CONTINENT		PENNSYLVANIA	
Type of Oil SAE 30	Conv. Ref'd.	Solv. Ext.	Solv. Ext.	Solv. Ext.	Conv. Ref'd.	Solv. Ext.
Viscosity Index	43	55	85	95	103	104
Engine Deposit Rating	85	89	91	90	89	91
Bearing Loss in Wt. Ave. ½ Bearing, gms.	.082	.075	.054	.046	.068	.048
DRAIN ANALYSES						
Conradson Carbon, %	1.50	1.20	.91	1.90	1.54	1.35
Naphtha Insol., %	.73	1.10	.04	1.10	.87	.32
Chloroform Sol., %	.31	.73	.08	.58	.32	.18
Vis. Increase, %	54	2	10	2.5	12	0
Neutralization No.	1.60	1.14	.40	1.30	1.32	.98

Table 6—500-Hour G-M Diesel Engine Test Results on Various Base Oils

Type of Oil SAE 30	Naphthenic and Mid-Cont. Conv. Ref'd.	Mid-Cont. Solvent Extracted	Penna. Solvent Extracted
Viscosity Index	60	90	98
ENGINE INSPECTION			
Freedom of Rings	1 stuck 1 tight	1 stuck 2 tight	5 tight
Carbon Behind Rings	medium to light	medium	medium to heavy
Oil Ring Slots	clear	clear	clear
Lands	medium deposits	medium deposits	medium deposits
Skirts	light deposits	light deposits	light to med. deposits
Liner Ports Clear, %	85	70	65
BEARING LOSS IN WT., mgs.			
Ave. ½ Bearing, Rod	47	39	108
Ave. ½ Bearing, Main	42	24	76
DRAIN ANALYSES, at 500 hours			
Conradson Carbon, %	.89	1.15	.73
Naphtha Insol., %	.95	.79	.31
Neutralization No.	1.30	1.60	1.37

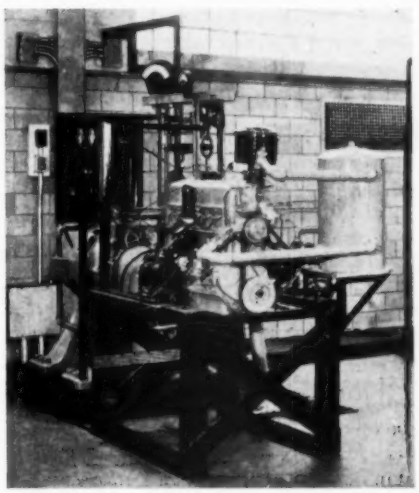


Fig. 4—Standard 1942 model Chevrolet passenger car engine used for the L-4 36-hour test. The engine develops 30 h.p. at 3150 r.p.m.

amount of oil ring filling. The oil compounded with the additive, however, was run to 180 hours with very satisfactory detergency, no ring sticking, only slight oil ring filling and no copper lead bearing weight loss due to corrosion.

Since these pre-evaluation tests showed promising results, the L-4 Chevrolet 36-Hour Oil Oxidation Test was run on both of these materials, the results being shown in Table 9. This comparison of the untreated with the compounded oil is interesting only as a means of showing the severity of the test in terms of a conventional oil, the service performance of which is well known. The engine rating was very substantially improved by use of the additive as was the resistance to bearing corrosion and oil oxidation, as shown by the decided improvements in bearing conditions and oil analysis values at the end of the test. The differences in overall engine ratings of 76 to 89 include a summary of conditions of pistons, rocker arm assembly, valve cover, side plate, and crankcase. This rating system has been quite well standardized as a means of evaluating all tests run on this procedure.

Table 9—Results on United Refining Oil on Chevrolet 36-Hour Test

Type of Oil SAE 30	Base Oil Only	Base Oil With Additive
Engine Deposit Rating	76	89
Bearing Loss in Wt., ave. ½ bearing, gms.	.533	.044
DRAIN ANALYSES		
Conradson Carbon, %	4.11	2.80
Naphtha Insol., %	2.4	1.3
Chloroform Sol., %	1.8	1.1
Viscosity Increase, %	73.0	27.0
Neutralization No.	1.10	.74

Some Corrosion Indicated

A comparison of the copper lead bearings for these same tests illustrates the tendency for all uncompounded oils to show corrosion when subjected to these test conditions. Weight losses for the bearings using the untreated oil were approximately one gram per whole bearing, while the bearings using the prospective heavy-duty oil showed an average of only .040 grams and correspondingly better surface condition.

For further comparison, results of this L-4 test on the United Refining Co. oil have been added to those shown in a previous table (Table 5), a rather extensive series of SAE 30 grade oils, all compounded with the same additive. These results are given in Table 10. It will be noted that the engine rating, resistance to bearing corrosion and drain oil conditions are comparable with those obtained with the other oils. Consequently, it would be expected that this product has a good chance to receive a satisfactory rating on the L-4 test as required for 2-104B qualification.

An L-3 test recently completed on the United Refining Co. oil gave the following information:

Top crown cutting; light to medium.

Piston skirt condition; light discoloration.

Ring lands; light lacquer to clean.

Sides of rings; clean.

Ring groove deposits; light carbon to lacquer.

Bearing wt. losses; avg. 11 mgs./brg.

Bearing surface condition; good.

Having presented this summary of our limited experiences in custom-fitting additives to more than 65 combinations of base stocks, we are definitely of the opinion that there *is* an answer to this question of evaluating base oils for heavy-duty service—a simple, straightforward answer for which there is no satisfactory alternative. That answer is actually to try every individual combination and not draw conclusions as to the ultimate results until all data are available and experience has confirmed the findings. This sounds somewhat like a theorist's dream or a research engineer's Utopia, but if one stops to analyze the developments of the past years there is unquestionable proof that this system has been effective.

The consolidation of 8 different oils of 7 viscosity grades each into one type of all-purpose product limited to only the SAE 10, 30 and 50 grades has resulted in a simplification of supply, relief to storage and distribution systems, minimizing of possibility of error, and provision of effective lubrication previously unknown in commercial practice and of unlimited value to the present military operations.

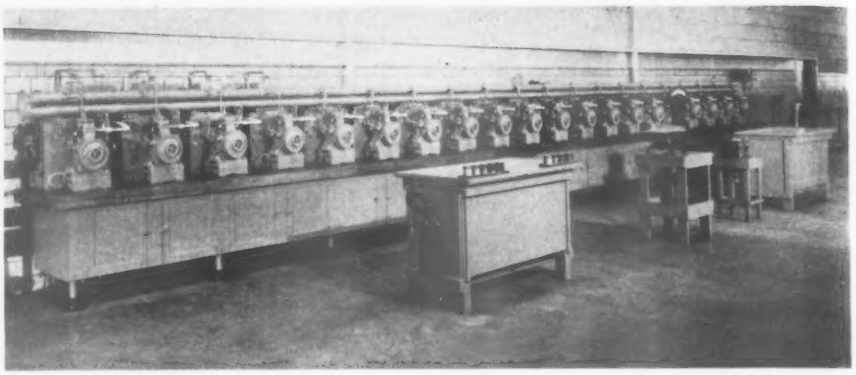


Fig. 6—A bank of 20 single cylinder Lauson engines used for making pre-evaluation tests on heavy-duty motor oils

Table 8—Comparison of Franklin Creek Oil with Other Base Oils on Chevrolet 36-Hour Test

Type of Oil SAE 10	Naphthenic Solv. Ext.	Mid-Cont. Solv. Ext.	Mid-Cont. Solv. Ext.	Penna. Solv. Ext.	Franklin Creek
Engine Deposit Rating	85	83	80	86	82
Bearing Loss in Wt., ave. ½ bearing, gms.	.131	.135	.142	.107	.131
DRAIN ANALYSES					
Conradson Carbon, %	1.50	2.30	1.50	2.02	1.48
Naphtha Insol., %	.73	1.39	1.00	.75	.69
Chloroform Sol., %	.31	.57	.60	.35	.28
Viscosity Increase, %	54.0	41.0	26.0	22.0	26.2
Neutralization No.	1.60	1.60	1.50	3.05	1.77

A Few Conclusions

Those points which we feel are fundamental to the correct evaluation of base oils for heavy duty service include:

1. Neither the source of crude, method of refining, nor type of additive compound alone can guarantee acceptability for heavy-duty oil qualification.

2. Not all oils are equally susceptible to improvement with a given additive and not all additives provide the same degree of effectiveness with a given base oil.

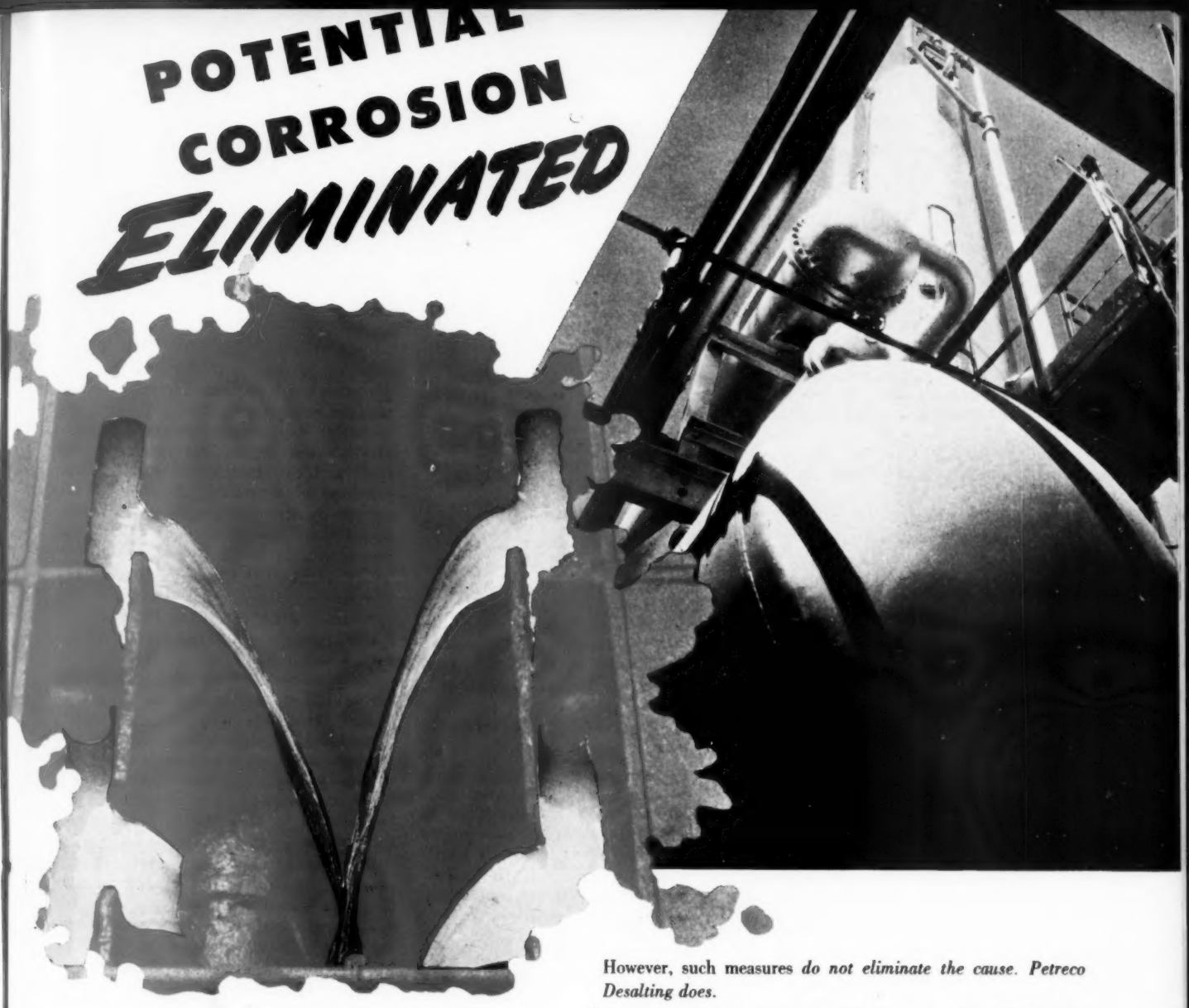
3. An inherently inferior base oil cannot be transformed into a superior product by the simple expedient of compounding with an additive.

4. Careful selection, intelligent application and extensive investigation of base oil and additive combinations are essential to the successful development of an oil for heavy duty service.

Table 10—Comparison of United Refining Oil with Various Other Base Oils on Chevrolet 36-Hour Test

Type of Oil SAE 30	Naphthenic Solv. Ext.	Mid-Cont. Solv. Ext.	Mid-Cont. Solv. Ext.	Penna. Conv. Ref'd.	United Refining
Engine Deposit Rating	89	90	91	89	89
Bearing Loss in Wt., ave. ½ bearing, gms.	.075	.046	.054	.068	.044
DRAIN ANALYSES					
Conradson Carbon, %	1.20	1.90	.91	1.54	2.80
Naphtha Insol., %	1.10	1.10	.04	.87	1.30
Chloroform Sol., %	.73	.58	.08	.32	1.10
Viscosity Increase, %	2.0	2.5	10.0	12.0	27.0
Neutralization No.	1.14	1.30	.40	1.32	.74

POTENTIAL CORROSION ELIMINATED



The photograph above shows effluent water from Petreco Desalters pouring into a refinery sewer. Carried away in this water are many harmful salts and impurities which, if not extracted, are the source of serious operating troubles.

Virtually every refiner will concede that salts in the crude charge cause operating difficulties. From salts are evolved the highly corrosive HCl, the cause of metal losses in furnaces, exchangers, lines and towers. Salts cause exchangers and tower-trays to become plugged. Certain salts build a scale on the inside of lines, condenser and exchanger tubes. Coke formed from salty oils is extremely hard, and often is deposited very rapidly. Such *effects* can, to a limited degree, be combatted with chemical neutralization, metallurgical improvements and frequent cleanouts. However, such measures *do not eliminate the cause. Petreco Desalting does.*

Petreco Desalters are consistently extracting 90 to 98% of the salt in the crude charged. In many refineries this has materially reduced corrosion, eliminated salt plugging, and decreased coke formation. On-stream time has been increased as much as 1000% in some cases. Petreco Engineers are familiar with the results Petreco Desalting is getting in refineries everywhere... Why not discuss your salt problem with one, *now?*

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HAND TOOLS ARE WARTIME CASUALTY

In Face of Replacement Difficulties, Plant Operators Use Various Means to Emphasize Importance of Their Proper Use and Care

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The wartime scarcity of hand tools and other miscellaneous small items used in refinery maintenance is throwing the spotlight on plant systems for educating workers in the proper use of this equipment and in carefulness to prevent their actual loss.

The recruitment of new and unskilled hands, both men and women, for plant workers is adding to this problem of refinery management. "The old heads have been reasonably careful about small tools and they realize that today's scarcities make necessary still greater care on their part to use the tools properly and return them to their proper places," said one plant manager. "The newcomers have to be carefully trained on these points, however."

A practical method of tool control is a definite part of a plant economy program used by the Standard Oil Co. of Louisiana, which method was inaugurated before the war came along. In its present form it is the result of trial and error and it is still undergoing revision. As described here it applies for the most part to the company's Baton Rouge refinery. There is, however, no centralized, company-wide control of this economy program; instead control is left to each department and plant. Modified as circumstances demand, it can be applied by other oil companies to the care of small tools or other refinery equipment and materials, much as it is used in other divisions of the Standard of Louisiana's operations.

The reason why centralized control has been abandoned in favor of departmental control is that the former is considered unwieldy and insufficiently flexible. Rules and procedure effective in a relatively small area, such as a refinery, have been found inappropriate for a pipeline department, or a production department; production maintenance requirements are far different from those of a well-drilling crew. Thus, each department must control its own tools in its own area; just as it is required to exert utmost economy in all its operations.

Part of a General Economy Program

The general economy program, started three years prior to Pearl Harbor, is described by a company official as "a systematic program for conservation of equipment, elimination of waste, good housekeeping, and an expansion and intensification of the effort toward the salvage of all possible materials and idle equipment." An article on Standard of Louisiana's program to conserve steam appeared earlier.*

The economy program at the Baton Rouge refinery applies to all employes of the manufacturing department, embracing all items of controllable expense, including material, time, labor and utilities, but not necessarily limited to them. The program is coordinated through the Training Department, operating mainly through the supervisory group, just like the Safety Program. Direct contact with employes is through plant bulletin boards and articles in the plant house organ, "The Stanoclan." Bulletin boards are located at plant entrances, in the various buildings, and in some cases, next to machines.

Direct approach to the rank and file of workers also is attained in vocational training classes. What better time to teach the care, maintenance and proper use of tools than when a man is learning a craft where he will use them? Process Job Training Classes, mandatory for process employes in certain departments and held for 40 minutes once each 3 weeks, are made an added opportunity to teach tool use and care while instruction to improve general efficiency of the group is being imparted. Supervisors are expected to "harp" on tool care and maintenance whenever the need and opportunity present themselves.

Tool Costs Watched

In the management family, responsibility for keeping an eye on expenditures for tools is placed with the maintenance engineer attached to the mechanical department, as far as the refinery is concerned. In other departments, such as pipeline and production, a similar control is set up by districts or leases.

Here is how the tool conservation portion of the economy program works, using the pipe department as an example:

In the Pipe Department, each gang is furnished with a certain number of tools. For replacements a member acting for the gang goes to the pipe department tool keeper and requests whatever is needed. The tool keeper then advises the department head when his supplies get low and the necessary replacements are requested from the maintenance engineer.

In this way, the maintenance engineer sees all the requisitions for additional tools and can exercise control of their purchase when needed. Requisitions are signed by the division head of maintenance and construction; it is his responsibility to bring unusual conditions to the attention of the mechanical superintendent.

Control over excess tool costs and thefts is simple. All along the line, from department tool keeper through department head to maintenance engineer and mechanical superintendent, an order for replacement tools may be questioned. If an excess of replacements is indicated prompt investigation follows. If the situation is general, publicity through bulletins or articles in "The Stanoclan" may be resorted to as a means of stopping the trouble.

In order to secure a replacement or new tool, the individual gang must ask the pipe department tool keeper. (In the shops, where tools are checked out individually, request is made to the shop tool keeper.) For a replacement, the old tool must be displayed for inspection. If examination reveals abuse, the job supervisor is advised. If a tool has been lost under unusual circumstances, this also is reported.

While employes are not required to pay for company equipment lost or ruined on the job, cases of continued carelessness or proven theft are handled as individual conditions require. An exception to this is safety equipment, goggles, shoes, and so on, which are assigned and charged to the men individually, and they must pay for replacements.

Proper Use Explained

An article entitled "Economy and Safety Points Re. Tools," which appeared in "The Stanoclan" carried illustrations of a number of commonly-used tools, accompanied by a brief discussion of the tool's cost and proper use.

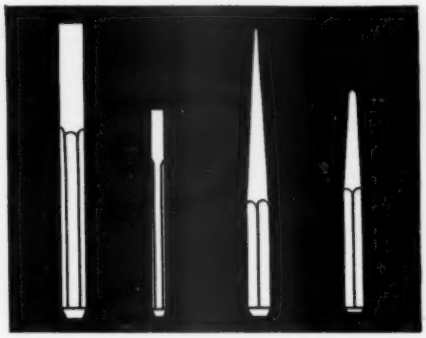
"Three things to remember about use of tools," stated this article. "1—Always use the right tool for the job in hand. 2—After you get the right tool, see that it is in good condition. 3—After you get the right tool and see that it is in good condition, use it in the correct manner.

"Simple rules, you say? Yes, they are simple—too simple, apparently, for many

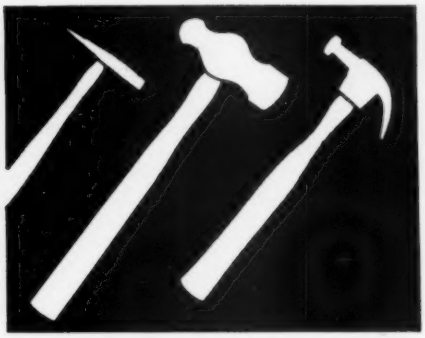
*"Conserving Steam to Meet Wartime Load on Boilers", Technical Supplement, NATIONAL PETROLEUM NEWS, March 3, 1943, p. R-105.

EVEN COMMON VARIETIES HARD TO REPLACE

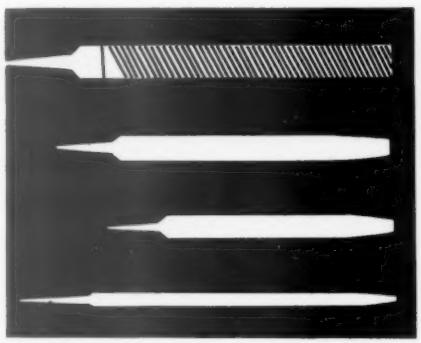
WRECKING BAR—Good ones cost 20c to $1.90 and may take up to 6 weeks to obtain by priority regardless of price. Without priority you do without



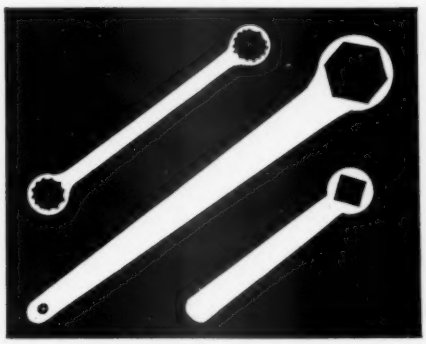
CHISELS and PUNCHES—Cold chisels cost $4-16 a dozen; punches 35-75c each. Some sizes in stock, wait 3-4 weeks for others. None without a priority



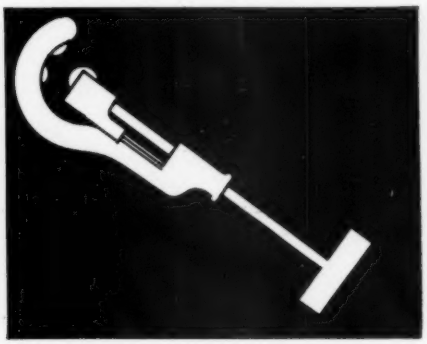
HAMMERS — Metalsmith's, Machinist's and Carpenter's. Cost from $1-2 and you may wait 3-4 weeks for delivery on a maintenance and repair priority rating



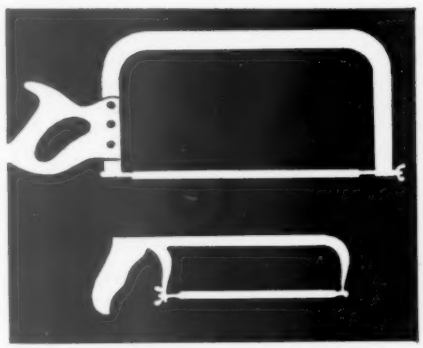
FILES—Cost from $3 to $20 per dozen. Some in stock, others delivered in 3-4 weeks, still others next to impossible to get regardless of priority



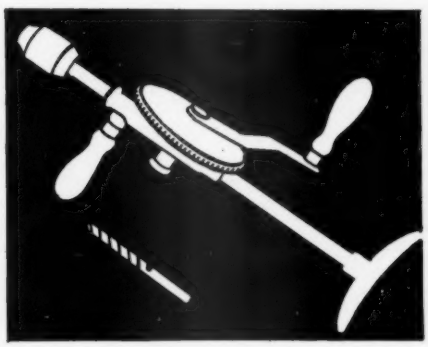
BOX-END WRENCHES — Square types cost $1-5; hexagonal $2-20. Multiple point costs about the same. Except unusual sizes, all obtainable with priority



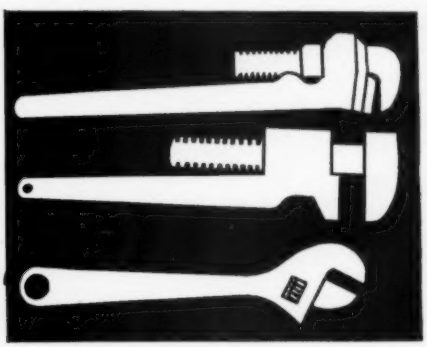
PIPE CUTTERS—List from $4.50 to $50, but except for unusual sizes you can get from stock if you have a maintenance and repair priority



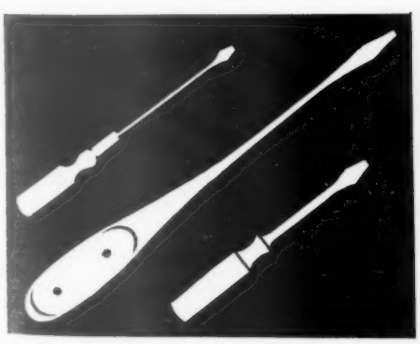
HACKSAWS—Frames cost 15c to $6.50, blades cost $40 to $832 a gross. Common sized frames usually in stock or on 2 weeks' wait. Blades may take 3 weeks, or longer



BREAST DRILL and BIT — Drills are in stock for some sizes; take 3-4 weeks on others. Usual size costs $12; bits 10c-$2.50. Some hard to find even with priority

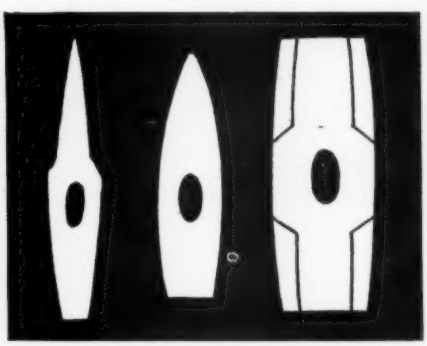


ADJUSTABLE WRENCHES—Pipe, Monkey and Adjustable end-wrenches illustrated. All cost from $2-$30 for good ones. Generally in stock if you have a priority



SCREWDRIVERS—Sizes from 2½ in. to 12 in. cost from 15c to 40c, higher for special alloys and sizes. Common sizes from stock with a priority

OPEN-END WRENCHES—These cost 50c to $9 but for certain sizes you may wait 3-4 weeks and for still other sizes a priority is just a hunting license



SLEDGE HAMMER and CUTTERS — priced from 55c to $2.50; handles few cents extra. Sledges may be in stock; cutters in 2 weeks or more

(List prices courtesy Machine Tool & Supply Co., Tulsa)

employes fail to follow them, and the result is: accidents and waste of time and tools."

Following are examples of how this article brought to the attention of the plant force the cost of individual tools frequently used:

"Stillson-type wrenches: Approximately 100 Stillson-type wrenches, costing on the average several dollars each, are drawn out of the storehouse every month to replace wrenches broken or lost. The storehouse carries a line of replacement parts for these wrenches, and it is therefore seldom necessary to completely discard one, unless it has been unreasonably abused. This large expense for wrenches broken or lost can be greatly decreased by care on the part of operators and mechanics who use wrenches. Avoid overstraining the tool and *do not use extension handles on wrenches,* for the tool is designed only for the force that one man can normally exert on its regular handle.

Use of Claw Hammer

"Claw Hammers: A good claw hammer will cost you about $1 and should last a long time if correctly used and kept in repair. Don't use a claw hammer for purposes where a machinist's hammer is required. The heads of these hammers may have a fine temper, and may chip when used on hard steel."

General rules were given in the same article for keeping tools in good repair, as follows:

"First: For purposes of safety. A tool in bad condition is an unsafe tool. Second: For purposes of economy. Tools cost little in proportion to the time of the mechanic using them. A man can work faster and better with a tool that is in perfect condition.

"If we want to economize on our tool costs, the first step is to see that the tools we have are kept in good, safe condition. The following general points on tool repair may prove helpful:

"(1) Keep cutting edges sharp: Whether it is a hatchet, a cold chisel, a saw, a knife, or a drill, the rule for safety and economy is: Keep the cutting edge sharp! It may sound queer to say that a sharp tool is safer than a dull one, but this has proved to be the case in practice.

"(2) Keep handles in perfect condition: Whether it is a shovel, hammer, axe, saw, screw-driver, or file, the rule for safety and economy is: Be sure to keep the handle in good condition. And keep the tool tight on the handle! Cracked wooden handles are unsafe handles on any tool. Replace them immediately. Keep wooden handles smooth by sandpapering.

Mushroom Heads a Danger

"(3) Don't tolerate mushroomed heads! For safety and economy, grind down those tools which show signs of mushrooming. Don't wait until you have a big mushroom on a tool before you decide to dress it down. Also remember to dress the tool on a radius of approximately ⅛ to ¼ the diameter of tool.

"(4) Use no wrenches with spread jaws: The jaws on wrenches which have spread wider than their original opening should be returned to the shop for readjustment. Spread jaws are unsafe; and they cause inefficent work.

"(5) Replace defective parts: If the teeth of a Stillson-type wrench have worn to a point where they will not take hold of the work, have the jaws replaced. Similarly, other defective parts of tools should be replaced as soon as possible."

Information on the proper use and care of small tools from the point of view of the safety of workers is available to refinery operators through the Safe Practices Pamphlets of the National Safety Council. Pamphlets Nos. 39, 41, 54, 59 and 76 will be found especially helpful. Safety instruction cards are also issued by the same organization and the following cards have been found particularly helpful by plant supervisors: No. 6, Hammers; No. 28, Cold Chisels; No. 31, Hammer Hints; No. 91, Portable Electric Tools; No. 111, Use of Wrenches; No. 123, Hand Saws; No. 176, Picks; No. 184, Sheaths for Tools; No. 192, Sharpening Hand Tools; No. 311, Track Wrenches; No. 343, Electric Hand Tools. This material can be secured from the National Safety Council, whose headquarters are 20 N. Wacker Drive, Chicago.

Safety Rules in Booklet

Concise rules for the use of hand tools are carried in the Plant Safety Rule Book of the Standard Oil Co. of Louisiana. These rules are as follows:

"A. Hand Tools:

1. Chisels for use with pneumatic tools must not be struck with a hand hammer. Never strike one tempered surface against another tempered surface, because of the danger of a piece of metal chipping off and flying.
2. Examine all tools and be sure that they are in good condition before using them. New handles must be put in at the carpenter shop. Care must be exercised to use the proper tool for the work at hand.
3. When using a sledge hammer, the man holding the bar or bull chisel should always stand in the safest place possible and the use of a chisel bar holder is recommended.
4. Care must be always exercised in carrying and using tools to avoid striking anyone passing or standing nearby.
5. Tools, having burrs or cracks, must not be used. They must be sent to the shop for reconditioning, and grinding off mushroom heads.
6. When using a wrench be sure the wrench fits the nut and in applying force use care, pull and do not push on the wrench.
7. In all locations where gas may be present, spark proof tools should be used. If they are not available, special precautions must be taken to prevent the striking of a spark. The use of water on steel tools, insulating covers or slings on ends of tools, wooden pieces between tools and wooden tools, themselves, are suggested. Special care to keep the steel tools from hitting or falling on another steel surface or concrete must be exercised.
8. Files without handles must not be used.
9. Goggles must be worn in using tools as outlined in rules covering the wearing of goggles.

Examine Hose Couplings

"B. Pneumatic Tools:

1. Examine couplings in hose and hose connections to machines to see that they are safely attached and in good order and avoid kinks. Do not pull hose over obstructions, as there is a possibility of causing hose to become uncoupled. Protect all hose crossing roadways to keep vehicles from running over it.
2. Do not allow piston, die or tool to be shot from the machine and do not permit men to stand in line with machine when there is danger of its slipping off the work.
3. When changing tools or connecting and disconnecting them to air hose be sure that the air is turned off. Do not kink the hose to make connections.
4. Pneumatic hoists shall be kept in good condition. Cables shall be replaced as soon as they begin to show defects. In the operation of hoists care must be exercised to see that the cables are wound on the drum in a proper manner and that they do not become kinked.

"C. Chain Blocks:

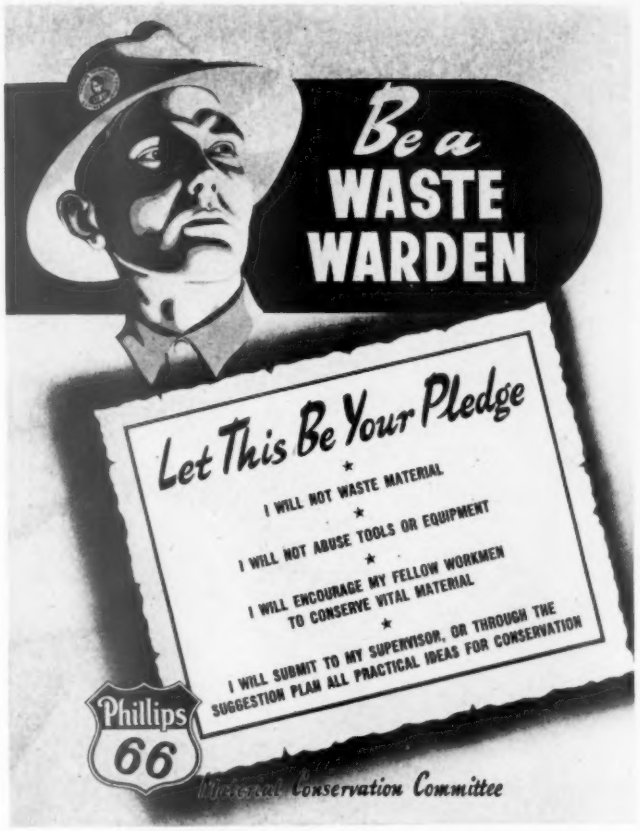
1. Chain blocks must be kept in good condition. Special attention must be given to see that the hooks and chains are always in good condition. When a block becomes in bad repair or a hook begins to open, the block must be sent to the machine shop for the necessary overhauling. Never try to repair a hook. Always get a new one.
2. Never attempt to use a chain block for a load greater than the capacity of the block."

Practices in Other Oil Companies

One representative major oil company makes this informal statement abouts its method of handling small tools:

"Small tools are treated in a dozen different ways according to divisions, departments and geographical locations—what applies to one group won't work for another.

"Refineries and gasoline plants, being concentrated within a reasonably small area, dispense all small tools from a centrally-located tool shop which is kept open 24 hours a day. The brass check system is their only method of bookkeeping and knowing what tools are out and what group of workmen has them. Some workers, such as electricians, repairmen, are given a set of tools especially designed for their jobs



THIS POSTER is used by Phillips Petroleum Co. to emphasize conservation of tools and other materials

IT'S HARD TO realize good wrenches, used like this every day, are unobtainable without a priority

and are expected to be able to account for them at any time. However, research reveals that no employe has ever been docked for lost tools—they are only chewed up about them.

"Production department workers, being isolated in many cases, as for instance, pumpers, are accountable to their lease foreman and he, in turn, to the district superintendent, for small tools. Pulling units are responsible for their especially allocated small tools and have an excellent record of accountability, because, no doubt, they are separate, mobile units entirely dependent for their jobs on the tools at hand. A popular bookkeeping system for small shops and repair units is the tool board on which is painted the outline of each tool to be hung on it, revealing at a glance what is in or out of shop.

Repair Angle Stressed

"All small tools are purchased through the Purchasing department like any other equipment, except, of course, when it is sensible to buy locally, or, as now, wherever the article can be found. Through our conservation committees, operating in each department, we have intensified the old program regarding small tools. Nothing new had to be put into effect because, we find, it has always been a point of cost reduction and efficiency with our operating departments. A little more stress has been put on the "keep it in repair" angle than ever before. Our safety department frequently emphasizes the necessity of a working tool for the job when it is needed.

"No separate accounting is made of small tools—there is no summary of annual investment—such items are a part of our perpetual inventory kept at every warehouse and dispensing point, and unless each tool to be classified as 'small tools' could be listed and records compiled, there is no way of knowing exactly whether our employes are getting better or worse about their handling and use of such equipment. The general verbal consensus is that our old employes, having been harped at for years, are doing better and rather well—new ones have to be taught and many a small tool will be lost or swiped in the process."

General opinion among several other oil company managers is that there is no good way to prevent theft other than watchful care on the part of supervisors and tool keepers and appropriate discharges of offenders when and if caught. One refiner partially meets the problem by requiring employes to supply their own personal small hand tools as a job requirement. These items are relatively inexpensive, he said, and include claw and machinists' hammers, screwdrivers, saws, pliers, squares, small stillson-type wrenches and other commonly-used tools. In his refinery, another manager said, he personally has found and returned to the storeroom within a recent period several cold chisels, a pipe wrench and other miscellaneous tools. This was rank carelessness and not attempted theft, he pointed out, because the effects of weather were apparent. Another, reporting much the same thing, also has frequently found and returned miscellaneous tools.

Centralized Control Opposed

Most companies say a centralized control system for tools and miscellaneous items is not satisfactory. "Too much control" does not give flexibility of operation when needed, they say. Most leave such control up to the individual division and, frequently, individual departments of the division. It is the exception rather than the rule to have a centralized accounting system which would indicate to management when tool replacement expenditures get "out of line." The general set-up requires the department to function within a budget set by management for its operation. It is up to the department head to stay within his budget. Request for additional appropriation or an unusually large budget becomes management's signal for appropriate explanation or investigation.

Several purchasing agents said, however, that the cost of tools for replacement was going down from peacetime highs, indicating the men are being more careful as they find the company storehouse "out" of items formerly plentiful. Most of these men indicated there is no formal company program of educating employes toward tool-saving, although some said this was part of conservation "propaganda" on bulletin boards.

A Tag Means

A VALVE OUTCAST

Repaired alloy valves. Some have been tested and given an OK tag and are ready for use. Those in foreground are safety valves, in the background are line valves

TAG IS THE WORD around which has been built a successful valve conservation program at the big Whiting refinery of the Standard Oil Co. of Indiana.

When the regular inspection discloses a faulty valve, a conspicuous yellow REPAIR tag is at once wired to it. That means it has to be removed and, still bearing the tag, sent to the shop for repairs. If a valve is found in need of repairs between regular inspections, on it goes to a large red HOLD tag. That means remove it and hold for the inspector to determine what work is necessary. When a valve is ready for service again, it receives a blue OK tag, which also tells where it is to be installed.

For inspection, maintenance and repair purposes, all valves in the Whiting plant are divided into two general categories: (1) those for ordinary services, which include steam, air, water, low-temperature and non-corrosive product transfer, and (2) valves for high-temperature, high-pressure, and corrosive products. Valves in the second category are more expensive and are now difficult to obtain because of their content of critical metals.

Even valves in the first classification, designated hereafter in this article as "ordinary" and embracing standard steel, cast iron, brass, and bronze construction, are inspected, although they do not receive the careful internal examination accorded others in more critical service. Generally, ordinary valves are pulled out of service only when something goes wrong with them: When they begin to leak, freeze open or closed; when the stem gets twisted off, or the valve is otherwise damaged. However, these valves and the lines on which they are installed are subject to annual or semi-annual external inspection, the frequency of examination determined by the program of the individual department. If the valve "acts up" during checking or looks as though it needed attention, it is taken out of service.

Valves in critical service, where temperatures and pressures are high or where corrosion also enters into the picture, are inspected during regular shut-down periods for the equipment on which they are installed. Such service includes thermal or catalytic cracking units, polymerization, 100-octane gasoline components, etc. This does not mean that each valve is torn down for examination at every shut-down, but from the experience records kept on each valve (to be discussed later) inspection frequency is determined. However, certain valves in known "trouble areas" are inspected at every shut-down. Also, if a valve shows signs of improper functioning during on-stream operation, or leaks develop, the trouble is reported to the inspection department by the unit's operator. The valve is inspected and immediately replaced if necessary.

When the inspector condemns a valve, it is removed from the unit and sent to the Mechanical Department for repair. If it is removed between inspections, it is put aside for inspection, either at the unit or at the Mechanical Department.

When valves are removed on an inspector's order he tags them with a yellow tag marked "Repair." On the reverse side the tag bears the number of the valve, date removed, unit from which removed and position occupied, repairs to be made, and inspector's name. A stub on the tag, which is sent to the Engineering Inspection Department, bears the same information except that the reason for removal is given rather than repair instructions.

If a valve is removed without an inspector's order, a red "Hold" tag is attached, signifying that it may not be repaired until inspected. This tag and stub gives the same information as the "Repair" tag, except that the reason for removal and comment by the person ordering the removal are substituted for the repair instructions. The stub also is sent to the Engineering Inspection Department. Upon inspection, the inspector attaches the "Repair" tag in place of the "Hold" tag.

Ordinary valves are repaired in the valve maintenance section of the Salvage Yard. Generally they bear no instructions from the Inspection Department unless they have been removed from a line during regular inspection. The order of a valve's selection from the "for repair" pile for reconditioning depends on the needs of the departments using that valve and the usable stock on hand. Valve sizes and types most urgently needed are of course repaired first. Whether urgently needed or not, repair procedure is the same.

The valve first is disassembled, wire-brushed if needed, and cleaned in gas-oil. The workman doing the job then inspects it inside and out. If, in his judgment, gates, seats, stems, etc., are beyond repair and will require new parts, the foreman in charge must O. K. the necessity for new parts. Otherwise the old parts are reconditioned and replaced.

Generally, most valves need a thorough cleaning, together with grinding and lapping of seats and discs, so they will seat properly and not leak. It may, however, be necessary to replace a disc, plug, or seat; the bonnet, stem and body of the valve seldom need replace-

ment. On valves smaller than 2½ inches, broken bonnets or bodies are not repaired but instead are sent to the scrap pile. These parts in larger valves, provided they are not severely damaged, are patched up by calling the Mechanical Department in on the problem. All parts which can be salvaged, however, are put in second-hand or replacement stock.

Generally no attempt is made to rebuild a gate or plug, or build up a seat. If these parts cannot be put in working order by grinding and lapping, or by use of a collar behind the shoulder of a valve seat to thrust it outward into proper relationship to the gate or plunger, they are discarded and scrapped.

When repairs are completed, the valves are hydraulic-tested by the repairer to rated capacity. These men take great pride in their work, and no valve leaves the repair section until it is in first-class condition. When tests are completed, the valve is painted and sent to the stockroom, ready for service again.

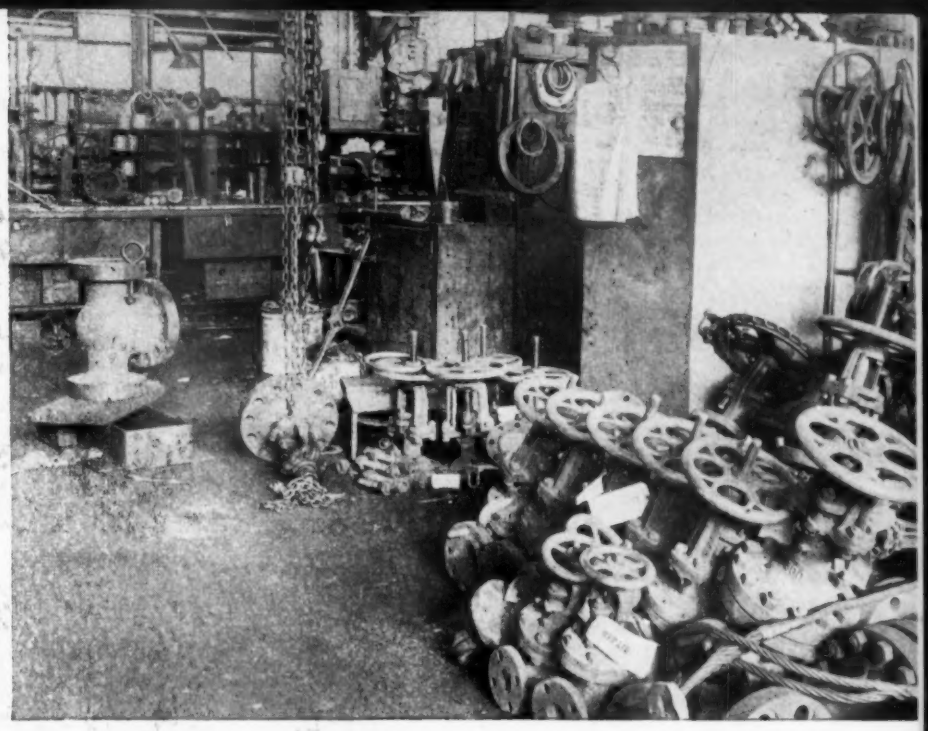
The reason for no major repairs on ordinary valves in normal times is economics. Valves below 2½ inches are relatively inexpensive, as are the parts. Up to now supply of repair parts and new valves themselves have been adequate although not plentiful. The maintenance section actually loses money in repairing these small valves; repairs were never attempted until wartime made it necessary.

Valves 2½ inches and larger, because of their greater initial cost, permit savings through repair and replacement of used and damaged parts to more than balance labor and new-parts cost. Further, these "profits" absorb the "loss" in repairing valves smaller than 2½ inches. Thus the repair of all sizes of valves pays for itself, as well as freeing critical materials for other war uses.

Actual cash savings by this maintenance program are not available, but it is known that a valve lasts 2 to 3 times as long with this system of maintenance as it would without. Thus extensive scrapping of serviceable parts is avoided and large savings in critical materials are achieved.

Repairs to special service valves, hereinafter called "alloy" valves, present entirely different problems from those encountered in reconditioning ordinary valves. Alloy valves are frequently subjected to corrosive conditions, may be rendered faulty by coke depositions, eroded by high-stream velocities, or become mechanically damaged when foreign objects lodge in the seat. Rarely are they damaged through abuse. All alloy valves go to the Mechanical Department shops for necessary repairs.

Upon receipt, the Mechanical Department may either repair the valve immediately (if it happens to be a rush job for which replacements are scarce or unavailable) or store it to await its turn at the repair bench. In either case reconditioning procedure is the same, and all damaged parts, regardless of whether or not they were responsible for the



Group of alloy valves tagged and awaiting repairs. Valve at left has been dismantled for preliminary estimate of work to be done. Workbench stocked with wrenches to remove seats is visible in background

inspector's condemnation, are put in first-class shape before being pronounced OK. If the valve is considered beyond repair by the inspector, or if this should be determined during disassembly prior to repair, all re-usable parts are salvaged and the rest discarded as scrap. This includes even the bolts holding bonnet to body.

The general repair case usually involves a worn, chipped or otherwise damaged plug, gate, or seat, with perhaps hard coke and a thin place or crack in the body as complicating factors. If possible, the seat rings of a gate valve are unscrewed or driven out, placed in a lathe, and refaced if in extremely bad condition. If the seat is worn too thin for further use by corrosion, damage, or from previous repairs, or if damage extends through the hard surface-finish, it is discarded rather than built up with weld metal because of cheap cost and relative ease in securing new rings. Occasionally it is impossible to drive out or unscrew the old seat; in this case the valve is put in a lathe, the old seat bored out, and a new one fitted.

Reduction in seat ring thickness can occasionally be remedied by inserting a collar behind the shoulder of the ring —a "shim" effect. An oversized gate also may be used to compensate for wear and permit the gate to close properly without going to the limit of its travel. Extra-thick unfinished rings are ordered from the valve manufacturer and installed to accomplish the same purpose.

Special wrenches have been made by the department to expedite the work of removing screwed-type ring seats, or plug seats on some types of relief valves. These will not work on pressed-in or expanded seats which must be driven out manually and generally are not recovered in a condition which permits re-use. The seat wrenches, as illustrated on p. R-516, are of diversified form to suit the purpose, yet cost little to make. Through the years quite a stock of these wrenches has been built up, each for an individual type valve; this stock is added to from time to time as necessary. Most of them are a convenient length of round or rectangular bar stock with the ends grooved or bearing projections to fit corresponding grooves or lugs on the ring. For large diameter valves, wrenches are T-shaped for lightness and convenience in handling; bar of the T is welded to the stem.

Worn valve gates almost never are so badly damaged that repairs are unfeasible. The face is built up to the required thickness by stainless steel weld metal, then ground to the proper thickness and taper, and hand filed to a perfect fit when installed. Only one face of the gate is built up at a time, the other face left untouched until the built-up face has been ground to the proper taper, and then it in turn is built up and ground to taper. Grinding is done in a standard precision grinder equipped with a tapered, soft iron jig held in a magnetic chuck. Taper angle of the jig is complementary to that of the gate, thus holding the gate face to be ground in a horizontal position. Clamps on the jig, which fit guide slots on the gate, assure that the taper of the two faces of the gate will be in proper orientation to the vertical diameter of the gate and to each other. The gate must finally be fitted to an individual valve by hand filing and lapping performed by a competent machinist.

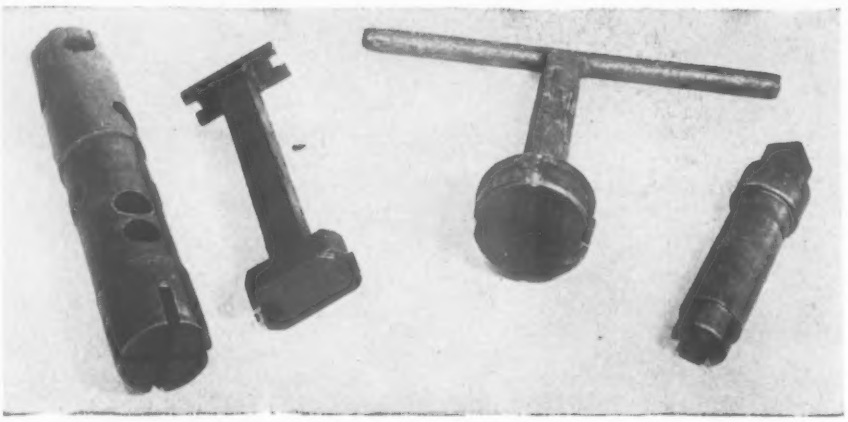
Thin spots in the body (determined by the inspector) or cracks and holes are built up with weld metal of the same composition as the body, and the part

stress-relieved and heat treated to requirements of good engineering practice as designated by the inspector.

Valve seat threads in alloy valves frequently become "coked up." The deposit is difficult to remove and threads may be damaged during seat removal. Discs with intermittent teeth on their circumferences have been made which true up threads and remove carbon deposits simultaneously.

Horizontally-placed seats in safety valves are difficult to remove for refinishing. The only way to repair these seats without special tools is to chuck them in a lathe and make the necessarily delicate adjustments assuring proper seat refinishing. To get around this, special seat-refinishing tools (below) were purchased from the valve manufacturer which do the job in, usually, 15 to 25 minutes. This tool is bolted to the body of the valve just like the bonnet. On the spindle end is bolted a cutter head which carries from 2 to 4 cutting bits, depending on size and shape of seat. Each of these cutters has a special function: One cuts the seat surface, another the tapered center, still another the outside clearance; all are in exact relationship to one another. A number of cutter heads of different sizes for different valves fit one tool. The shops have 3 tools and numerous heads for each. It requires just a few turns of the adjustable-length spindle by the operator to complete the work after the cutting head is properly adjusted for depth of cut. Hand lapping to finish fit requires only a few minutes more, and then the valve is ready for reassembly, packing, setting to proper value, and a final hydraulic test.

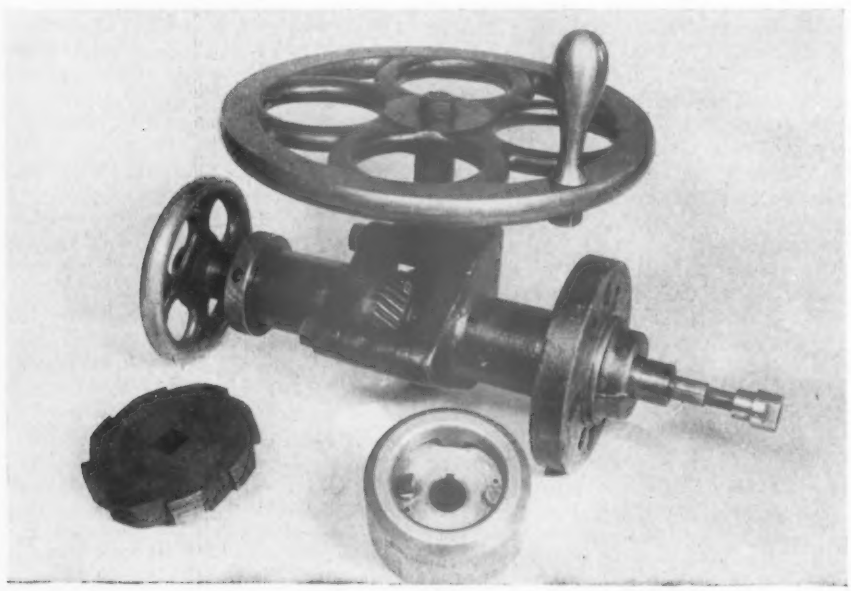
When repairs are completed on any valve, the person doing the repair work makes the final hydraulic test to valve rating or setting (stamped on the valve by the manufacturer). He then attaches a blue OK tag to the valve before returning it to the unit from whence it came. This tag bears the valve number, unit and position where it is to be installed, repairer's name, date, and any remarks. Stub of this tag is not detached from the tag until the valve is reinstalled. Space is provided on the stub for listing valve number, unit and position on which installed, who installed it, and the date of installation.



A few of the tools developed by machinists at the Whiting plant to facilitate the removal of the seats from safety and line valves. They illustrate the diversity of tools required in the company's valve maintenance program

The Engineering Inspection Department maintains a record of all alloy valves. This record, largely made from the stubs of the tags previously mentioned, gives the date the individual valve was purchased, when it went into service, where on an individual unit, and what repairs have been necessary. From this record, "trouble spots" in an individual unit can be determined and also how frequently a valve at that point should be inspected to catch damage before it goes too far. Then, too, the information is used in scheduling purchases of replacement valves well ahead of the time they probably will be needed; this helps the company and also the manufacturer.

Here again, no exact record of money savings through maintenance and reconditioning is available. But the valves last 2 or 3 times longer than if discarded when they become unusable. The valves are for the most part 4-6% chrome alloy steel and may weigh several hundred pounds. Under today's conditions, the company considers that the savings in critical materials as well as the scarcity of the valves themselves makes any monetary savings pale into relative insignificance.



Valve reseating machine for 1- to 6-in. valves and (lower right) one of the reseating tools used with the machine, showing within the tool the cutting heads which do the work. Lower left, cutter for removing carbon from threads for valve seats

CATALYSTS FOR

- ALKYLATION
- ISOMERIZATION
- DEHYDROGENATION
- HYDROFORMING
- HYDROGENATION
- POLYMERIZATION
- DEHYDRATION

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- Anhydrous Hydrofluoric Acid
- Boron Trifluoride
- Aluminum Chloride
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PELLETS AND POWDER:

- Activated Alumina
- Chrome Alumina
- Molybdenum Alumina
- Tungsten Alumina

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Cobalt	Phosphorous
Iron	Thorium
Magnesia	Titanium
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Cell Type Oil Heater Performance*

A type of heater is described as designed and constructed to meet volume and uniform heating requirements of a large crude oil cracking unit. Advantages are direct up-draft flow of gases of combustion from the furnace floor past the radiant and convection sections; simplified flow of the oil charge and accessibility of all headers for cleaning and repair. Operating data is included to show the overall thermal efficiency.

AMONG present day oil refinery direct-fired heaters, the "cell type" has attracted unusual attention due to exceptional records of performance and because of certain inherent physical characteristics of particular advantage to the operators. These desirable qualities are most pronounced where large capacities are concerned and where forced shutdowns are expensive and involve other elaborate installations. Features of particular interest include:

1. Flow of oil may be divided between a number of parallel passes, thus reducing pressure drop and pumping costs.

2. Series-flow through each pass assures positive flow throughout the coil. Coke formation can be more readily detected by increased pressure drop, or decreased flow of oil, through the coil. In most multi-flow arrangements, coking of one or more tubes does not necessarily affect the pressure drop, or reduce the flow noticeably.

3. The use of a large number of smaller tubes reduces the time during which the oil is at maximum temperature. This is important in many heating cycles where the oil is sensitive to high temperature.

Provides Simple Gas Flow

4. The cell construction is combined with up-draft firing of the heater, giving simple gas flow without baffles or turns.

In 1940 a 25,000-bbl. per day crude oil distillation unit was designed and constructed for one of the major refining companies. The requirement was to heat the crude charge from 385° F. to 670° F. with a vaporization of 75%. The large quantity of oil involved and the necessity for heating it uniformly were conditions best met by the cell type heater, and for that reason the use of three heaters was decided upon, in place of one large unit.

In the final design, each heater carries an equal portion of the oil and the flow through each heater is divided into two streams, giving a total of 6 parallel flows for the installation. The superheater located at the top of the convection section heats the exhaust steam for use in oil stripping.

Oil Flow Simplified

A diagrammatic section through one of the heaters is shown in Fig. 1, together with the operating conditions, which may be described as follows:

1. Direct, up-draft flow of the gases of combustion from burners in the furnace floor, past radiant and convection sections to the breeching and stack.

2. Simplified oil-flow; two separate coils per furnace, one on each side. The charging oil is divided into the two flows at the inlet (in the upper portion of the convection section) and flows downward, counter to the flow of the gases. From the last tube in the convection section, the oil is piped out of the furnace and re-enters at the bottom in the first tube of the radiant section, whence it flows upward into a header, which connects the two flows at the outlet of the heater.

3. The inside diameter of the oil coil tubing is increased from 3.4 in. at the heater entrance to 4.8 in. at the exit. This increase in cross sectional area is necessary to accommodate the greater volume resulting from vaporization. It also effectively decreases the pressure drop through the heater and permits maximum vaporization in the tubes at a minimum temperature.

Accessible for Repairs

4. Ready accessibility of all headers facilitates repairs and cleaning.

5. Flexibility of operation. A tube failure or leaky header in one of the 3 heaters does not necessitate a complete shutdown. Operation will proceed at two-thirds capacity until repairs are made.

(The accompanying photographs and the illustration on the front cover show the three heaters during construction, completed and in operation, and as a part of the completed distillation unit.)

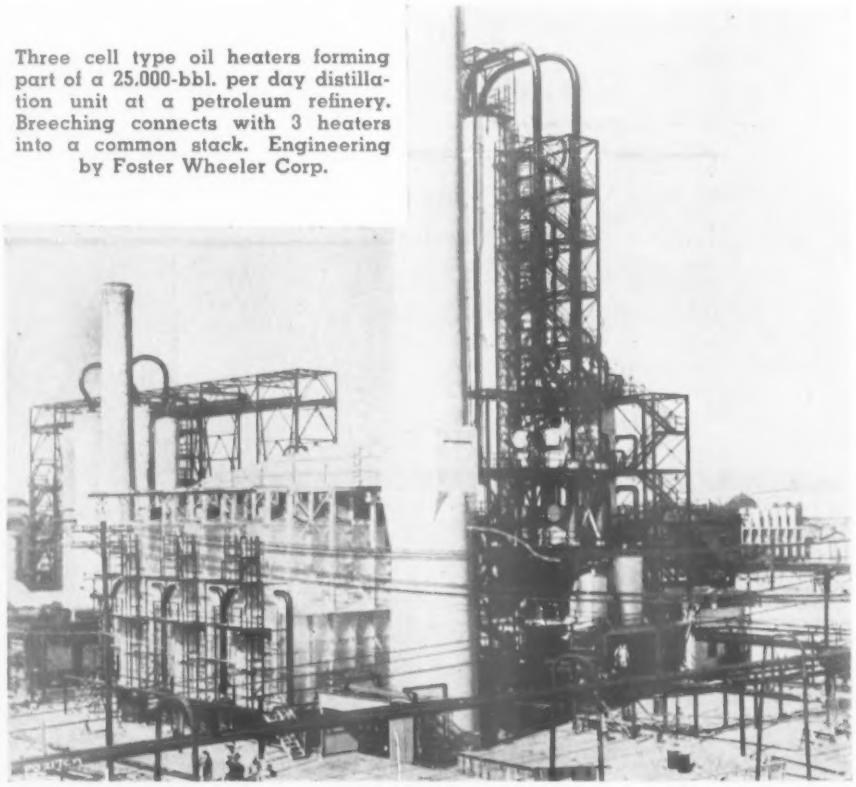
Operating Data

Averages of data obtained during a 24 hour test period are listed below for the three heaters.

Throughput: 26,000 bbl. per day of 38.5 API crude oil.

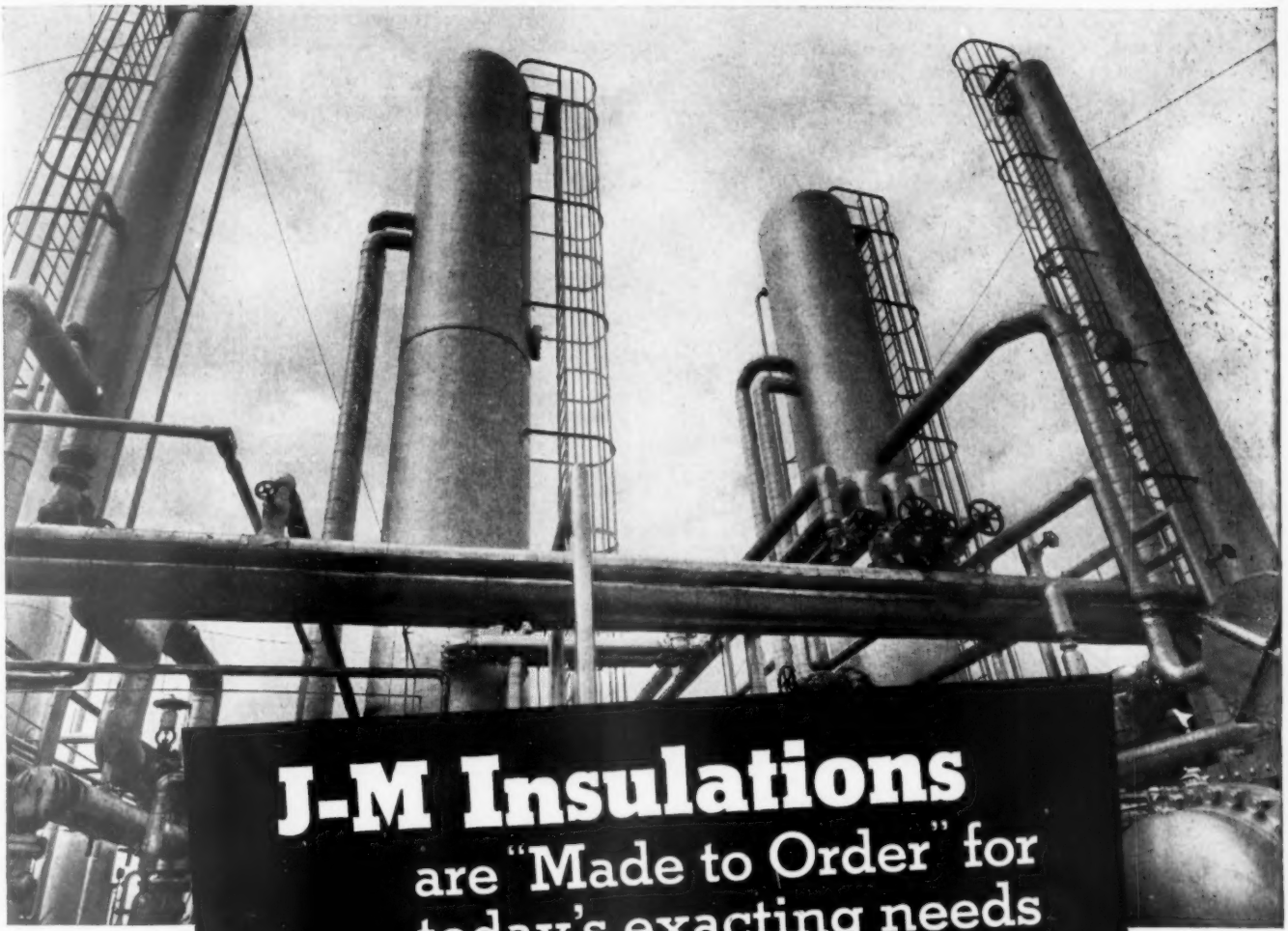
Temperature, °F. Oil

Entering Heater	385
At 50% Convection Coil, 26.6% total coil	400
At Outlet Convection Coil, 55.0% total coil	480
At 33.3% Radiant Coil, 70.0% total coil	545
At 66.6% Radiant Coil, 86.6% total coil	605
Leaving Heater	670



Three cell type oil heaters forming part of a 25,000-bbl. per day distillation unit at a petroleum refinery. Breeching connects with 3 heaters into a common stack. Engineering by Foster Wheeler Corp.

*From Heat Engineering, of Foster Wheeler Corp., March-April, 1943.



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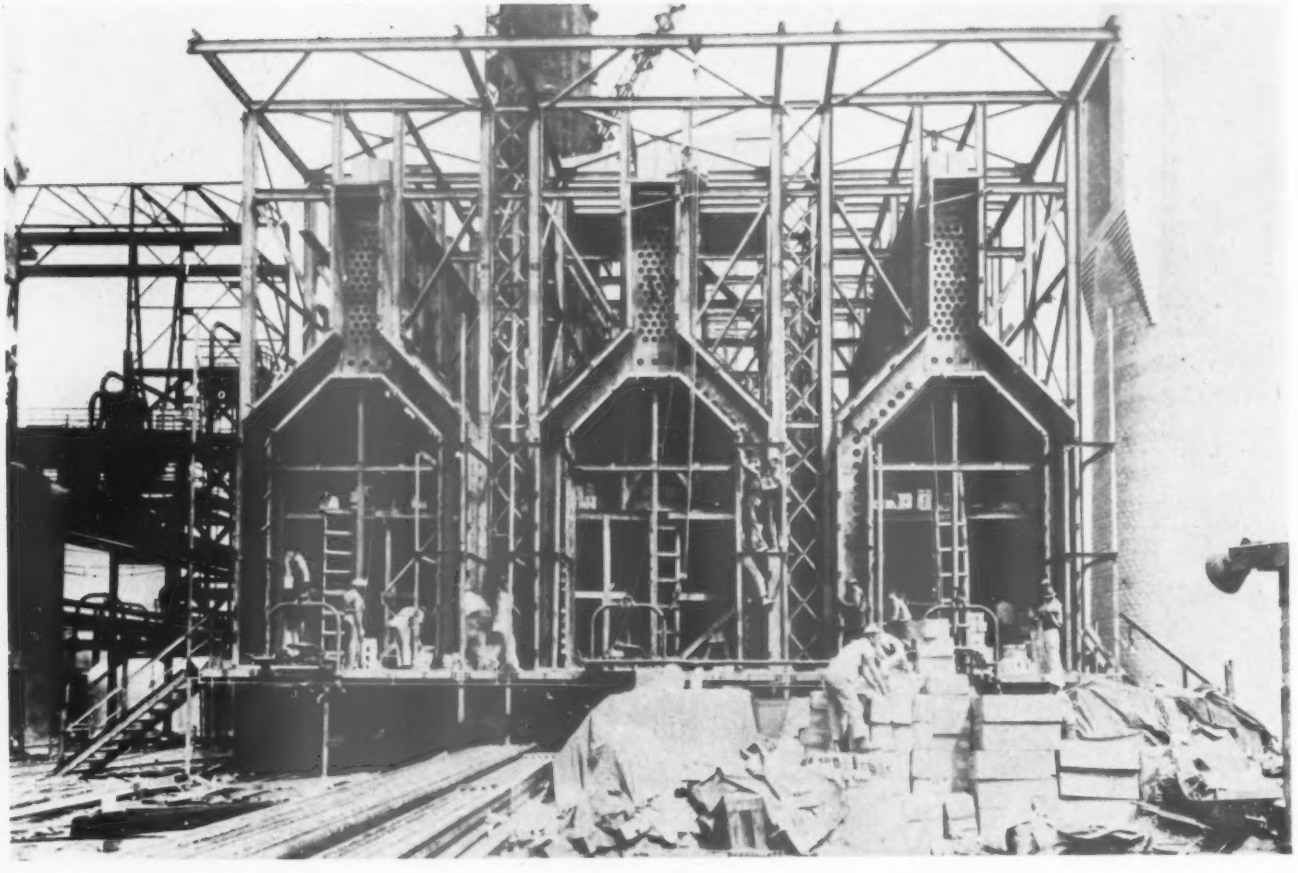

Heaters during construction, showing compact and simplified design of tube supports and header construction

Temperature, °F. Combustion Gases

Entering Convection Section	1225
Between Convection Section Oil Tubes and Steam Superheater	585
After Steam Superheater Tubes, leaving furnace	555

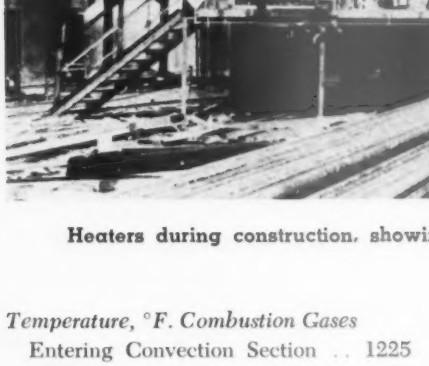

Fig. 1—Diagrammatic section of single cell type heater, showing oil and combustion gas flow and operating data at certain points

Temperature, °F. Steam

Entering Superheater Tubes	250
Leaving Superheater Tubes	420

Pressure Psi

Inlet to coil	150
Outlet	10

Combustion Data

Fuel Gas, Btu., net per cubic ft.	1383
Excess Air, %	17.9
Heat Liberation—Millions of Btu. per hour	107.7

Comments on Operating Data

1. The gas temperature entering convection section was not excessive (1225°F.) and is obtained through moderate transfer rates in the radiant section.

2. The 200°F. differential between the entering oil and the exit combustion gases is lower than ordinarily experienced in oil heating in this temperature range.

3. At a vaporization of 75%, the 150 lb. per sq. in. pressure at the inlet to the heater is somewhat lower than the average for heaters of this combined capacity and represents a very satisfactory pressure level.

4. An overall thermal efficiency of 84.0% (based on net heating value of the fuel) is a good indication of the combined effect of the desirable design and operating features of this type of heater.

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SAFETY has been designed, and engineered, and constructed into the plants for manufacturing the new petroleum products.

Even though the processes for making these new products have been taken direct from the pilot plant stage to commercial operations within less than two years in many cases, the mechanical safety features incorporated represent another chapter in the wartime achievements of the technologists of the petroleum, rubber and other industries. They have not only provided the methods for producing in huge volume the new products needed for overpowering our enemies, but also maintained full consideration for the safety of the plant operators.

The work of installing the safety precautions in these new plants started long before the plants were actually designed, in the research departments of the oil and other companies. The properties of the new hydrocarbons that were to be handled were carefully studied to determine the concentrations where toxic effects occurred, their inflammability limits and other conditions. Information developed in this research aided in the design of the plants.

The safety features included in the design and construction of plants and their operations were described, for manufacture of butadiene, styrene, synthetic rubber, and alkylate for aviation gasoline by the hydrofluoric acid process, at special sessions of the Petroleum and Rubber Sections of the National Safety Council in Chicago Oct. 5-7. Papers presented are published in the following pages.

SAFETY PRECAUTIONS IN MANUFACTURING BUTADIENE*

751.5

By C. E. Starr, Jr.**

Data on the inflammability limits of butadiene-air mixtures are presented and requirements given for volumes of two inert gases to render the hydrocarbon gas non-inflammable. Reactions due to the chemical reactivity of butadiene are described, the principal one being the formation of polymers with evolution of heat. Throughout the plant operations, methods have been adopted to avoid contaminating butadiene with air, since the peroxides accelerate the formation of polymer. The safety precautions adopted cover the storage and transfer of the product, processing operations throughout and the loading of tank cars, and sampling and testing in the laboratory.

ONE of the most important compounds consumed by the synthetic rubber processes is butadiene. Butadiene is considered to be a "light hydrocarbon", meaning it is normally a gas. In contrast to motor and aviation fuels, butadiene is a single hydrocarbon and has a constant boiling point (25.5°F.) while the motor fuels are complex-mixtures of hydrocarbons and have a boiling range (90 to 400°F. by ASTM distillation). This means that, when heated, butadiene changes to a gas rapidly, as contrasted to gradual vaporization experienced for conventional fuels. This property, as well as its high vapor pressure, are significant factors in safety considerations. Butadiene is approximately twice as heavy as air. It is handled in the refinery both in gaseous and liquid states.

This hydrocarbon, comprising four atoms of carbon and six of hydrogen, is termed a diolefin; its deficiency in hydrogen contributes to its chemical reactivity. Butane, such as is derived from natural gasoline, for example, comprises four atoms of carbon and ten atoms of hydrogen and is considered by the chemist to be "saturated", that is, having a full complement of hydrogen atoms for the carbon atoms present. The chemical reactivity of butadiene is an important factor in safety considerations.

Butadiene is derived from petroleum by several processes such as the cracking of gas oils under low pressure and high temperature and the catalytic dehydrogenation of butane and butylene. The butadiene from these processes is extracted from dilute solutions and is distilled to high purity.

With butadiene there are, of course, the normal hazards attendant to handling any light hydrocarbon or mixture of light hydrocarbons, such as fires, rupture of containers due to expansion of the liquefied gas or due to pressure build-up of the contained gas, and the formation of explosive mixtures, caused usually by leaks or careless purging of lines or vessels. In addition to these normal hazards, butadiene and butadiene-containing streams present certain physiological hazards not normally encountered with saturated light hydrocarbons and certain hazards are attributable to the chemical reactivity of this hydrocarbon.

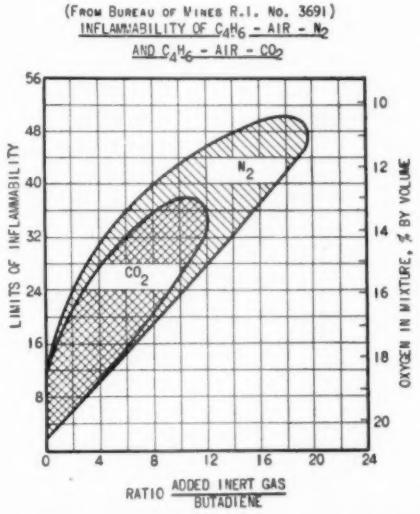

Fig. 1—Volumes of nitrogen and carbon dioxide required for each volume of butadiene to make all mixtures with air non-inflammable

Hazards Due to Explosive Mixtures

Information on limits of inflammability of butadiene-air mixtures and of butadiene-air-nitrogen (or butadiene-air-carbon dioxide) mixtures is pertinent to safety work from the standpoint of (a) avoiding the compounding of an explosive mixture and (b) preparing suitable mixtures for the safe removal of butadiene from containers or plant equipment. Jones and Kennedy in Bureau of Mines Reports of Investigations (1, 2) relate that the limits of inflammability of butadiene in air have been found to be 2% for the lower- and 11.5% for the upper-limit of inflammability.

Tests were made on butadiene-air mixtures to which various volumes of nitrogen and carbon dioxide were added both in the lower- and upper-limit range. Their data are shown graphically in Fig. 1, from which it is noted that at least 19.6 volumes of nitrogen must be added to each volume of butadiene to make all mixtures with air non-inflammable, while only 12 volumes of carbon dioxide are required. If less than these amounts are added the mixtures have inflammable limits as shown. The relation of butadiene to other light hydrocarbons and to hydrogen and carbon monoxide with regard to the limits of inflammability,

*Presented before Petroleum Section, National Safety Council, Chicago, Oct. 6, 1943.

**Esso Laboratories, Standard Oil Co. of Louisiana, Baton Rouge.

and to the requirements for inert gases to render the hydrocarbon gas non-inflammable under all conditions of dilution with air, is shown in Table I.

Excepting methane and ethylene, of the light hydrocarbons listed in Table I, butadiene has the broadest limits of inflammability. Jones and Kennedy[2] also provide useful information to show the minimum oxygen values that permit propagation of flame; these minimum values should be used as a guide to determine the extent to which the oxygen must be reduced to prevent explosions. Their data are summarized in Table II.

Information useful to the safety engineer with regard to the combustion of butadiene vapor-air mixtures is contained in another Bureau of Mines Report of Investigations,[3] written by W. J. Huff; this report lists the ignition temperatures for various butadiene-air mixtures as summarized in Table III. The data on inflammability limits and ignition temperatures show that butadiene must be handled with exceptional care in the plant and in the laboratory.

Hazards Due to Chemical Action

Hazards due to chemical change of butadiene are derived from four main reactions: (a) decomposition of butadiene with evolution of heat, (b) formation of polymers, which also takes place with evolution of heat, (c) reaction of butadiene with oxygen, and (d) the reaction of impurities in the butadiene, such as acetylenes, with oxygen, which in turn may catalyze the peroxidation or polymerization of butadiene, and the reaction of acetylenic impurities with metals to form explosive acetylides. As an example of the butadiene decomposition reaction, Scott [4] of Shell Development Co. has reported an explosion that occurred when butadiene was confined under pressure; this may have been initiated by hydro-static pressure from a bomb being completely filled at a lower temperature.

With regard to the formation of polymers, Robey, Wiese, and Morrell of the Esso Laboratories of the Standard Oil Development Co. [5] report extensively on the stability of butadiene. They emphasize that polymer formation is probably the most important degradation reaction likely to be encountered in the storage and handling of butadiene. Under conditions affording poor dissipation of heat, polymerization reactions can produce high localized temperatures and may proceed with extreme rapidity. The effects of temperature and of oxygen content on the polymerization of butadiene are summarized by the data in Table IV abstracted from the Robey, Wiese, and Morrell paper [5].

From these data it is obvious that (a) butadiene should be stored at as low a temperature as possible without reducing the pressure within the storage vessel below that of atmospheric pressure, thus creating the possibility of drawing in air which will react with butadiene, and (b) every possible precaution should be taken to keep air from contaminating butadiene even in small amounts, since peroxides of butadiene accelerate the formation of polymer.

Butadiene should be stored in the presence of an active inhibitor. It should be emphasized, however, that no inhibitor can be expected to last indefinitely and if butadiene is to be stored in the plant for a considerable period of time, the inhibitor content should be periodically checked by an analytical procedure suitable for determining the active inhibitor present.

It should also be pointed out that the addition of inhibitor to butadiene already containing peroxides cannot always be expected to reduce the active oxygen instantaneously. If peroxidation of butadiene has already taken place, to make the product suitable it is recommended that it be distilled in the presence of an adequate amount of peroxide-destroying substance, say by boiling under total reflux and in the presence of a high-boiling flux oil to prevent concentration of peroxides in the still pot or reboilers. Peroxide-destroying substances that can be used conveniently are pyrogallol and sodium hydroxide.

Butadiene peroxides can be violently explosive, as reported by Scott[4] who points out that peroxide formation may be affected by catalyst or inhibitors and can occur from exposure of butadiene to air. Even solid butadiene has been known to form peroxides and become explosive from exposure to air. Butadiene polymer is quite amenable to peroxidation. Since butadiene standing over a peroxide-containing polymer may not show the presence of peroxides, it is important to investigate the condition of any stored butadiene by sampling to determine the amount and condition of polymer present. An example of this condition is also related by Scott[4] who points out that polymer taken from the bottom of a crude butadiene tank was found to contain 0.095 equivalents of peroxide oxygen per 100 grams. This material, which was insoluble in bu-

TABLE II—Oxygen Values Below which Flames of Combustible Gases and Vapors Are Extinguished*

Combustible	O_2, percent by volume below which no mixture is inflammable (mixtures tested in 6-ft. explosion tube 2 in. in diameter; flame propagated upward) When N_2 is added to combustible-air mixture	When CO_2 is added to combustible-air mixture
Hydrogen	5.0	5.9
Carbon monoxide	5.6	5.9
Methane	12.1	14.6
Ethane	11.0	13.4
Propane	11.4	14.3
Butane	12.1	14.5
Pentane	12.1	14.4
Hexane	11.9	14.5
Ethylene	10.0	11.7
Propylene	11.5	14.1
Cyclopropane	11.7	13.9
Pittsburgh natural gas	12.0	14.4
Methylene dichloride	18.3	...
Butadiene	10.4	13.1

* From Bureau of Mines R. I. No. 3691

TABLE III—Ignition Temperatures of C_4H_6-Air Mixtures*

% Butadiene	Ignition Temp. °F.
2.1	508
2.9	490
5.0	455
6.9	436
9.1	432
10.6	429

*From Bureau of Mines R. I. No. 3602.

TABLE I—Extinction of Flames by Addition of Nitrogen And Carbon Dioxide*

Hydrocarbon	Limits of inflammability, % by volume Lower	Higher	Volumes of inert gases required to render 1 volume of hydrocarbon gas non-inflammable under all conditions of dilution with air N_2	CO_2	Ratio CO_2/N_2
Methane	5.00	15.0	6.0	3.3	0.55
Ethane	3.22	12.5	12.8	7.3	.57
Propane	2.37	9.5	14.9	7.9	.53
Butane	1.85	8.4	17.2	9.3	.54
Pentane	1.45	7.8	22.3	12.2	.55
Hexane	1.25	6.9	25.0	14.0	.56
Butadiene	2.00	11.5	19.6	12.0	.61
Ethylene	2.75	28.6	15.3	9.0	.59
Propylene	2.40	10.3	14.0	7.7	.55
Cyclopropane	2.45	10.4	13.5	8.0	.59
Hydrogen	4.00	74.2	16.5	10.2	.62
Carbon monox.	12.50	72.2	4.1	2.2	.54
Average	...	...	...	...	.57

* From Bureau of Mines R. I. No. 3691

TABLE IV—Polymerization of Butadiene

Test	Temp. °F.	ppm Active O_2	% Polymerized per hour
1	86	1	0.0007
2	86	13	0.0008
3	86	330	0.0056
4	140	1	0.0160
5	140	13	0.0300
6	180	1	0.15

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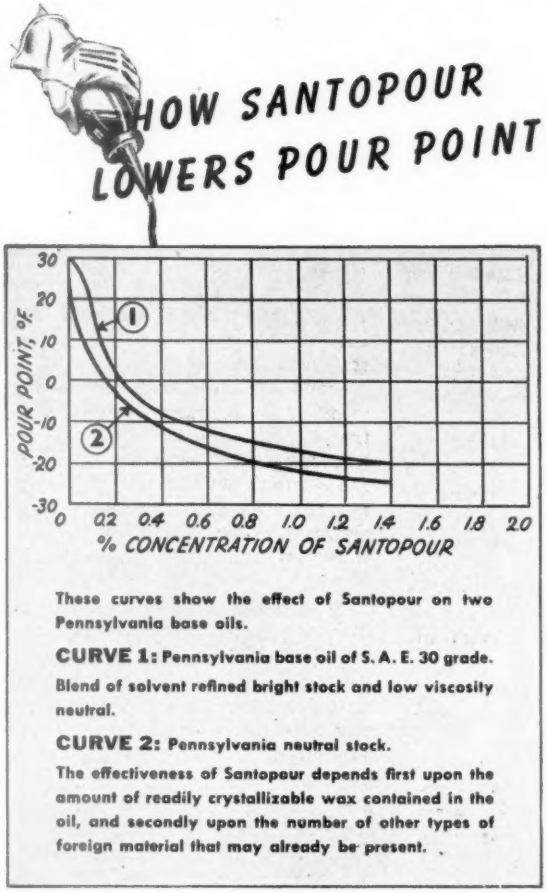

These curves show the effect of Santopour on two Pennsylvania base oils.

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tadiene, was easily detonated by hammer blow. The butadiene itself contained only traces of peroxides.

Butadiene which has been peroxidized should not be distilled to low bottoms content. The Esso Laboratories of the Standard Oil Development Co. conducted laboratory tests in which butadiene that had been peroxidized was permitted to evaporate under room conditions and when only a residue remained, the vessel was heated slowly on a sand bath. When the temperature reached 257°F. a violent decomposition took place. In the case of batch distillations of butadiene-containing materials, every effort should be made to prevent oxygen from being drawn into the still upon cooling down.

Depending on the method of manufacture, varying amounts of acetylenes may be present, such as methylacetylene, vinylacetylene, and ethylacetylene. In any event the quantities are usually small, on the order of 1% or less in process streams and less than 0.1% in the final product. Acetylenes will, however, react with metals, particularly copper, silver and mercury, and precautions must be taken to obviate such contacts; where contacting of these metals is necessary the accumulation of the metal acetylides should be prevented.

Physiological Effects

While in general, aliphatic or chain hydrocarbons are less toxic than the aromatic or ring-type hydrocarbons, diolefins, such as butadiene may be narcotic. However, the data on physiological effects of butadiene are not extensive. Larinow[6] and his associates in their studies of effect of butadiene on the organism by experiments on white mice, have shown that these compounds are slow narcotic poisons. They also irritate the mucous membranes of the eyes and the respiratory organs. Repeated poisoning may cause a condition in which there is air or gas in normally airless tissues or an excess of air in tissues normally containing a certain quantity of air.

Von Ottingen[7], writing in the Yale Journal of Biology and Medicine, points out that olefinic hydrocarbons are definitely more toxic than are the corresponding saturated compounds and that exposure to comparatively low concentrations may interfere with co-ordination, affect the memory and reduce the reaction time. He further points out that the introduction of a second double bond into olefins, resulting in the formation of diolefins such as butadiene, increases the narcotic action.

In man, inhalation of a 1% mixture of butadiene for five minutes causes, however, no effects other than a slight quickening of the pulse and a slight feeling of irritation and dryness in mouth and nose. Repeated and prolonged exposure to 6.3% may cause some irritation of the respiratory tract. Van Atta and Noyes[8] in a paper presented before the 31st National Safety Congress, pointed out that butadiene may produce irritation of the eyes and throat, but apparently has no cumulative effect. Below the lower explosive limit (2%) it is mildly narcotic and strongly so in higher concentrations. Investigators at the Mellon Institute report[9] that butadiene has a decided physiologically detrimental effect and that it varies noticeably with the individual. Blurring of vision and nausea are the characteristic symptoms so far noted. More results of their investigations will be made available.

From these studies it is certainly apparent that the safety engineer should take all reasonable precautions to eliminate the presence of butadiene from the air in the plant even though its concentration may be far below the explosive limit.

Storage and Handling in the Plant

Storage of butadiene at the Baton Rouge refinery of the Standard Oil Company of Louisiana is in spherical tanks. While not normally refrigerated, these tanks are equipped for some refrigeration by removing butadiene from the vapor space and returning through ammonia condensers. This precaution provides for the removal of heat if any polymerization occurs. Butadiene in storage is always inhibited and is periodically analyzed for peroxide content when extensive storage periods are encountered. To date no peroxide build-up has been experienced.

Before loading storage tanks with butadiene they are filled with water and the water is displaced with butadiene. This eliminates the necessity of purging any light flush gases which might otherwise be employed. The loading of butadiene in tank cars is accomplished by withdrawing from the bottom of the spheroids and pumping in through the dome of the tank car into a pipe extending to near the bottom.

Prior to loading, each tank is analyzed for oxygen content, and if it is found to be 0.1% or less the car is loaded. If the oxygen content is more than 0.1% the car is flushed with natural gas and is retested by the laboratory. After loading the tank cars another analysis is made of the vapor in the dome and if this contains more than 0.3% oxygen a small amount of purging is effected to reduce the oxygen content. It should be emphasized, therefore, in order to conserve butadiene that adequate steps be taken by each butadiene producer to employ a method of analysis which will accurately analyze oxygen content in the range of 0.1%. This cannot be accomplished with the ordinary Orsat apparatus but can be conducted by reaction of the oxygen in the gas with manganous hydroxide, yielding a product that can be titrated quite accurately.

In distilling butadiene in the plant, several precautions are taken. First, air is displaced from the equipment by water or if the equipment has been in service for a prolonged period of time it is thoroughly steamed and then displaced with water prior to entering the butadiene-containing stream. Flux oil, usually a kerosine, is added when butadiene is distilled in the final step for purity improvement in order to keep any polymers and peroxidized materials from concentrating in the still bottoms and in a concentrate from being subjected to high heat conditions.

In some cases, where the feed entering a distillation tower is super-heated, there exists a condition whereby the underneath portion of the plate above the feed becomes dry and such condition may be conducive to the formation of metal acetylides if the butadiene contains acetylenes, even in trace quantities. To avoid this situation a small amount of the oil used for scrubbing the product is injected into the gas flow at the point of entry to the tower; this reduces super-heat and permits the bottom of the plate above the feed to stay wet. When distillation towers are brought down for repairs they are usually steamed as mentioned, then filled with water. While the work is being conducted a small flow of water is continued in order to keep the metal surface wet and to prevent any accidental sparking from detonating the acetylide that may have formed.

Lines and cold tanks are displaced with water when starting up; when shutting down, this equipment is steamed and then flushed with water. Where reactors are used, such as in the case of catalytic dehydrogenation, before entering the hydrocarbon into the system they are flushed with inert gas, a mixture of nitrogen and CO_2. Compressors are operated with pressure in the suction maintained at a minimum of 0.5 lb. above atmospheric to prevent the entry of air.

The recommended steaming operations to prepare equipment in butadiene service for opening to air and for mechanical work, comprise heating for 16 hours, holding about 15 lb. back-pressure to maintain a temperature of 250°F. The steam is vented to the air. This treatment will render peroxidized materials and acetylides less active. Metal acetylides are not formed in locations where solutions are in constant circulation but occasionally have been found at stagnant liquid interfaces or on the walls of vessels where splashing sometimes takes place. Metal acetylides have been found in dead-end lines. Every effort should be made to minimize such situations, and to this end all mercury-containing meters and instruments in butadiene production service have water seal-pots attached to eliminate contact of the mercury with gas. Every effort should be made to minimize such situations. Where it is found that solids and polymers exist, they should be removed wet. Acetylides should be destroyed by acidification.

Another safety practice conducted in

the butadiene operations at Baton Rouge involves the return of all cooling water from exchangers to a disengaging drum to guard against the event that butadiene or butadiene-containing gases may become dissolved in water through leaks in the equipment, and subsequently be evolved in sewers with consequent formation of explosive mixtures. Any gas evolved from the disengaging drum is vented in the proper manner to obviate accumulation of gas. The removal of water from small vessels, such as reflux drums or feed surge tanks, where there is a tendency to accumulate water, is accomplished through a water leg and regulated by means of visual gages. The water is never drained below a fixed point and that withdrawn is sent to disengaging drums. Besides being a safe practice, such an installation prevents the loss of valuable butadiene.

Control rooms should be maintained under positive air pressure, with fresh air drawn in from an elevated position and exit air leaving through louvres located just off the floor. Along with the problem of handling butadiene, safety considerations must be given to the handling of the inhibitor added to butadiene prior to storage for shipment. The phenol-type of inhibitor usually employed causes severe burns when contacting skin. Further, some people are especially allergic to this inhibitor. Therefore all precautions usually taken for the handling of corrosive chemicals should be exercised in the handling of butadiene inhibitors. After handling, the skin should be thoroughly washed with alcohol, but precautions should be taken not to get alcohol in the eyes.

Sampling and Analyses

Butadiene contained in large cylinders is transferred by either of two methods. The most common is the utilization of regular cylinder nitrogen pressure for transferring butadiene from the original cylinder to the system involved. In this method the nitrogen cylinder is connected to the butadiene cylinder with a pressure regulator in between. This system is particularly useful and is safe for rapid unloading of large cylinders. The other method, which is slower, is simply that of removal of butadiene from its containing cylinder by its own vapor pressure. In no event, however, when utilizing this method should the cylinder be heated, as by a steam coil. Butadiene cylinders should not be opened to the air unless they are immediately flushed out with inert gas. Also before using cylinders in which butadiene has been contained, a thorough flushing should be made with inert gas. If it is found that a butadiene-containing cylinder has been exposed to air, then the cylinder should be thoroughly steamed and washed with a solvent which will remove any heavy polymer that may have been formed. In fact it is good safe practice regularly to clean all butadiene-service cylinders.

Small butadiene cylinders used to provide samples for laboratory tests should be filled after evacuating rather than by water displacement. In obtaining laboratory samples it is often necessary to refrigerate the cylinders in order to insure the condensation and the accumulation of the samples. In such cases the normal schedule for capacity allowance in terms of per cent of water content by weight should be modified to conform to the filling densities applicable to the temperatures of —10° and —70° F. Ordinary carbon steel cylinders may be used for any temperatures down to —20° F. If it is necessary to liquefy samples of butadiene-containing streams that may include propane or lighter gases, cylinders fabricated from KA$_2$S or similar alloy should be used and the temperature of the coolant bath should be no lower than —70° F.

Special weighing devices should be set up so that an accurate determination of the weight of sample can be made. This is usually quite difficult in the case of small cylinders where the ratio of the weight of cylinder to the weight of sample is very high. It is a good safe practice to have someone in authority observe all sampling and certify that the cylinder has been weighed and that the weight is within the tolerable limits or that sufficient product has been withdrawn from the sample container to permit liquid expansion. Cylinders employed in butadiene service should not be fitted with brass valves and in general should conform to ICC specification 4B-240. Laboratory sampling cylinders are usually unloaded by displacement of the liquid under its own vapor pressure.

Cylinders of liquefied gases, such as butadiene, should not be permitted to remain in the laboratory or in other enclosures any longer than necessary to make the required transfer of material, in view of the possibility that a leak in such quarters could cause a fire or an explosive mixture.

In testing butadiene in the laboratory, all precautions outlined for plant practice should be observed. Laboratory distillation equipment should be shielded and butadiene should never be distilled to a low per cent bottoms unless flux oil is added.

There are several methods of determining butadiene content, the most widely used being a gravimetric determination and a gas volumetric determination, both based on the principle of reacting butadiene with maleic anhydride. In the gravimetric procedure a weighed amount of liquefied sample is reacted with the maleic anhydride in a sealed tube, and after the reaction the tube is opened for subsequent tests. It should be emphasized that all operations from the time the tube is sealed until the reaction has ceased are extremely hazardous. The operators should wear protective glasses and heavy leather gloves, handle the sealed reaction tube with tongs and work behind a protective screen to avoid serious injury should the reaction tube explode.

We do not advocate for control purposes in the butadiene operations at Baton Rouge, the use of the gravimetric procedure because of safety considerations and because of the time of analysis required. Instead we analyze a gaseous sample by means of absorbing in maleic anhydride in a vessel that is not maintained under seal. The test is analogous to conventional absorption-type gas analyses. When a sample is removed from a pressure cylinder into the butadiene analysis apparatus it should be conducted through a safety trap to insure against pressure build-up. The maleic anhydride employed as a chemical reagent in the analysis of butadiene is toxic and should be handled as a corrosive and poisonous material.

In analyzing butadiene-containing streams for acetylenes, a silver acetylide is produced and this should be destroyed while wet by decomposing with an excess of acid ferrous sulfate solution. The acetylide should not be allowed to accumulate or become dry.

The safety engineer should give considerable thought and time to laboratory practice. Since laboratory equipment is usually altered more often than plant equipment and is frequently moved to new locations, those familiar with the material may consequently become careless in the handling. While a number of hazards have been described for butadiene operations, safety engineers will recognize, of course, that with study of the particular characteristics of this hydrocarbon and careful attention to safety precautions, no unusual safety conditions should exist.

There are many other problems of a safety nature in connection with the handling of butadiene, particularly as applied to the operations wherein butadiene is extracted and concentrated from crude butadiene streams where it exists in a dilute form. There are different processes for the extraction and purification of butadiene and the safety features pertinent to each of these is considered beyond the scope of the present paper.

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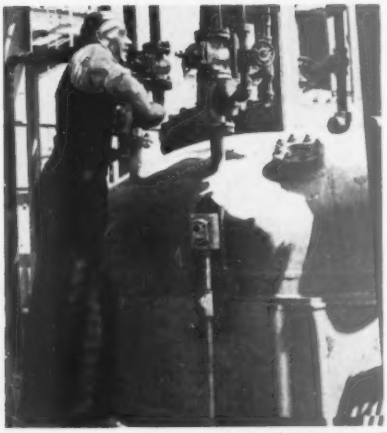
Mechanical Safety In Synthetic Rubber Plants*

By Glen D. Cross**



New synthetic rubber plant of Firestone Tire & Rubber Co. Upper left shows top of reaction vessel where polymerization of butadiene and styrene takes place

Precautionary measures in the synthetic rubber manufacturing plants start with protection from electric sparks at the unloading racks where butadiene and styrene are received. Liquid levels in storage tanks are maintained at a point to provide sufficient vapor space to permit expansion without increasing the pressure. Relief valves in the transfer system and the polymerization reactors permit discharge of vapors to a burning stack to provide against excessive pressures being built up. The adequate working of the relief valves at all times is essential.

IN ANY discussion of safety in the synthetic rubber industry, we must realize that, within a period of a little more than a year, this business has grown from a pilot plant stage with a negligible amount of actual production to the point where it is now a vital part of our war production effort.

In this short period, it has been necessary to design and build plants that will not only produce the necessary rubber but that will produce it in a safe manner. The importance of this last point can only be realized if one considers the vital equipment that goes into these plants and the training that is necessary to prepare personnel to operate them. Damage to this equipment or injuries to the operating personnel can greatly interrupt our rubber program. Therefore, the necessity for safe practices, safe conditions, and safe operating procedures is paramount.

As the most important type of synthetic rubber, now being manufactured, is the GR-S Type, safety connected with its manufacturing process will be discussed. The two main ingredients that go into GR-S rubber are butadiene, made from either petroleum or grain alcohol, and styrene, which comes from ethylene, a by-product of petroleum refining, and benzene, a coal tar derivative. The properties of these materials are as follows:

	Butadiene	Styrene
Boiling Point	23.7° F.	295° F.
Flash Point	—80° F.	90° F.
Explosive Limit	2% to 11.5%	1.1% to 6.1%
Specific Gravity:		
Vapor	1.877	3.604
Liquid	0.6263	0.9127

The manufacturing process itself involves the following major steps:

First, the styrene and butadiene are brought in by tank cars or through pipe lines from raw material manufacturing plants. The purified butadiene and the styrene are then pumped into polymerizers together with a soap emulsion, a catalyst, and a modifying agent. These ingredients are agitated in the polymerizer, bringing about a reaction that is controlled through the use of a water jacket on the reactor vessel or polymerizer. The latex, obtained from this reaction, is then coagulated by the addition of a coagulating agent. The coagulated rubber, in the form of a wet, sticky substance, is either passed over a filter which washes the rubber and removes a great amount of the moisture and is then shredded by a type of hammer mill, or it is put through a pelletizer which both removes a portion of the moisture and forms the rubber into small pellets. The small particles of rubber are next passed through a steam-heated dryer to remove the remaining moisture.

Safety Steps Outlined

The dry rubber is then pressed into bales, weighing approximately 75 pounds each, by either an automatic hydraulic baler or by a mechanical baler. The final operation is placing the baled rubber into cardboard boxes for shipping.

Some of the precautionary measures to be considered in unloading tank cars of styrene and butadiene, the 2 main raw materials, which constitutes the first step in the operation of a synthetic rubber plant are as follows:

1. The track at the unloading rack should be grounded, rails bonded, and an insulator placed in the track at the switch. These precautions (as well as those in item No. 2 of this list), are taken to prevent electric sparks from igniting the flammable materials while they are being unloaded.

2. There should be a bond between the track, unloading line, and the tank

*Presented before Rubber Section, National Safety Council, Chicago, Oct. 6, 1943.

**Safety Director, Synthetic Rubber Division, Firestone Tire & Rubber Co.

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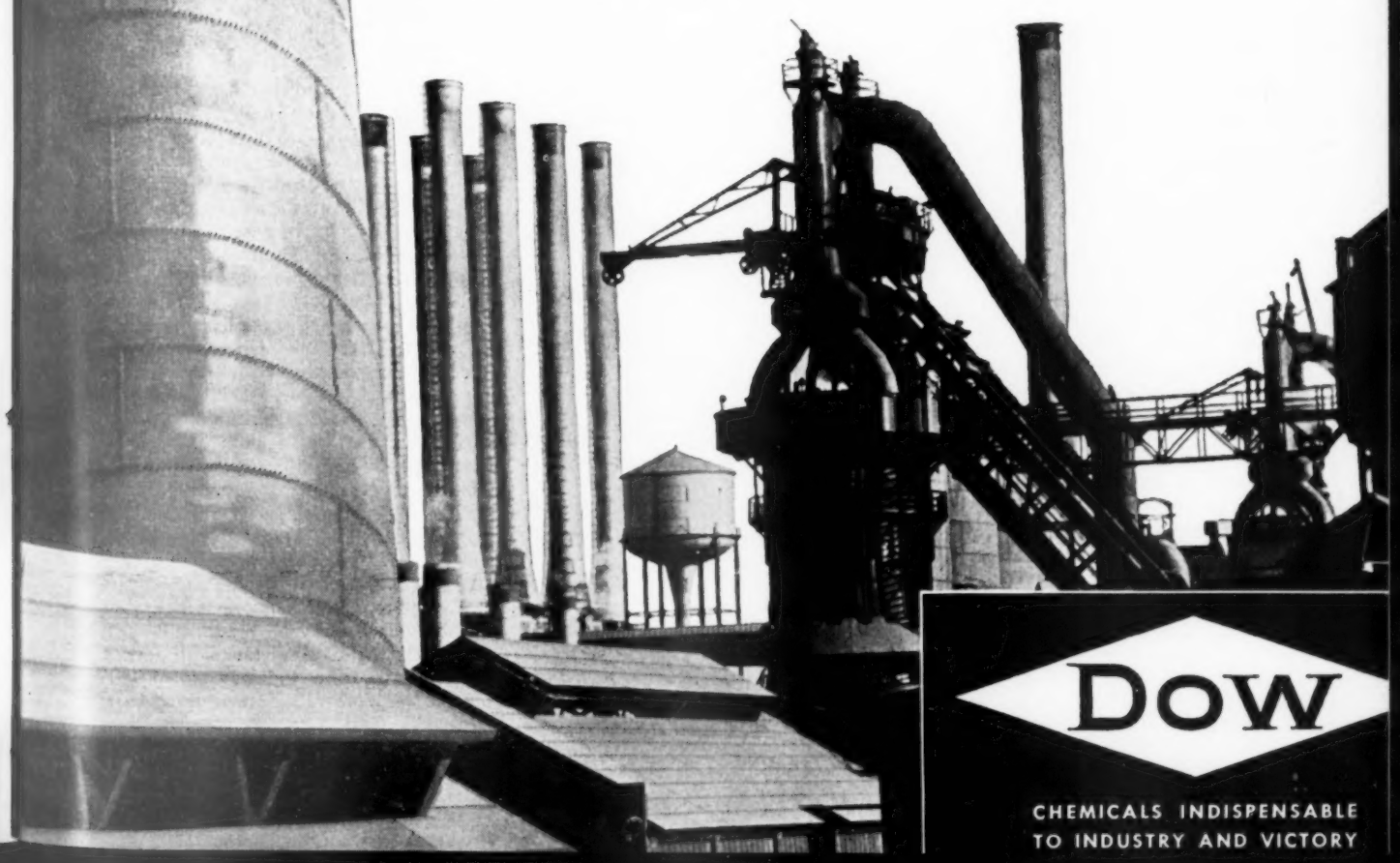

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shell. The unloading rack itself should also be grounded.

3. The tank car, while being unloaded, should be blocked and a "Tank Car Connected" sign placed on each side of the tank car, one car length away. It is also advisable to use a derail.

4. All electrical equipment at the unloading rack should be of the explosion-proof type.

5. It is advisable to use spark-proof tools at this location.

Precautions in Storage

Some of the safety measures which should be taken in the tank farm storage area, include:

1. Maximum liquid levels should be stated on storage tanks to indicate the maximum amount of liquid material to be stored at the various temperatures. Enough vapor space should be allowed above the liquid material to permit expansion without raising the pressure to any great degree in the vessel.

2. It is advisable to plug drains on tanks to prevent possible escape of the material through faulty valves or valves that have not been closed completely.

3. Periodic inspections should be made of all relief valves on tanks to make sure that they will operate at the desired pressure. A procedure for making these inspections is described in the latter part of this article.

4. It is necessary to have drains with quick-opening, remote-control valves in the diked areas to drain off the water below the burning liquid in case of a fire, if water is used as a control agent. Should drains not be provided, the diked area would fill with water and the flammable liquid, floating on top of the water, would spread over a large area and increase the damage caused by the fire. The size of the drains should be large enough to handle the greatest amount of water that ever would be deposited into the diked area involved.

5. Water sprays are used on styrene tanks to keep the temperature resulting from the sun's rays below 85° F. If the temperature is kept below this point, styrene will not form dimers, which are harmful to the manufacturing process as well as a definite fire hazard. It is thought that the formation of such dimers may cause spontaneous ignition of the styrene. As the flash point of styrene is also slightly above 85° F., an explosive mixture of styrene vapors will not be obtained if the water sprays on the styrene tanks keep the temperature below this point.

6. Another precaution against the formation of explosive mixtures and dimers includes the use of inert gas as a blanket over the styrene in the storage tanks. By doing this, air is excluded from the tank and the possibility of a flammable mixture inside the tank eliminated.

7. In practically all plants, relief valves on the butadiene storage tanks are tied into a main vent line which goes to a burning stack. It has been found desirable to keep this line to the burning stack filled with inert gas under a slight pressure to prevent the possibility of butadiene and air forming an explosive mixture in the vent line and at the base of the burning stack. In many plants, relief lines from the styrene tanks are tied into a vent line which runs to a styrene burning pit located at some distance from the storage area. It is also a good precaution to use inert gas in this line.

8. We have found it to be good practice to place small wire seals on valves in lines that bypass the relief valves on storage tanks. This prevents the promiscuous opening of such valves without the authorization of a top supervisor.

Handling Corrosive Materials

The storage of caustic and acid presents a definite hazard to employes if not handled correctly. Safe practices and conditions associated with these corrosive materials are:

1—The use of protective clothing of the proper type is a necessity in working with such materials. Additional safety is provided by emergency showers and eye fountains located at unloading racks, storage areas, pump houses, and process areas.

2—Foot-operated showers seem to be the most desirable, inasmuch as they can be turned on quickly and with a minimum amount of trouble. Eye fountains, operated also by treadles, are very effective. One large chemical company has built its own fountain of this type. It is similar to a regular drinking fountain, but has a small rubber cup at the discharge point. A small amount of water is kept running at all times, while the amount can be increased by stepping on the treadle at the bottom of the fountain.

3—It is also desirable to have available means of neutralizing and getting rid of the caustic or acid, should a large amount be spilled. Another precaution includes the placing of dikes around the storage tanks should such tanks be located near buildings or in areas where workmen are usually found.

4—As an added safety practice, shields may be placed around flanges or couplings in lines containing acid or caustic. Such shields prevent serious burns which may be caused by acid or caustic being released under pressure through a defective flange or coupling.

In addition to the main ingredients of butadiene and styrene, there are a number of chemicals used in smaller quantities in the manufacture of synthetic rubber. These are usually stored in drums, barrels, or bags. It has been necessary to study the properties of these materials to determine their flammability, dermatitis-producing qualities, and their reactions with each other when any two or three are brought into contact. This latter point is very important inasmuch as the reaction may cause enough heat to produce a fire.

As a precaution against such fires, dry chemicals should be placed on raised platforms, to prevent the possibility of their becoming damp or in contact with any spilled liquid chemicals. Liquid chemicals in drums should be segregated from other chemicals used. Any oxidizing materials should be stored between relatively non-combustible materials which will not react with the oxidizing chemicals. Good housekeeping is especially important in this storage area. Any material spilled on the floor should be immediately cleaned up and disposed of. Two places that are often neglected in housekeeping are the pits of elevator shaft-ways and weigh scales.

The use of aisle lines is helpful in providing adequate aisle space.

Mechanical lifts are desirable in handling material safely and in preventing lifting accidents.

Safety in Polymerization Unit

In the transfer of the raw materials into the polymerizing process, the hydrocarbons in the tank farm go from the storage tanks through the transfer pump house before being purified and placed in the polymerizers. As large quantities of these hydrocarbons pass through this pump house, it is imperative that all safety precautions be taken here.

The use of the color scheme recommended by the Rubber Reserve Co. to identify various pipe lines is of great aid in this pump house as well as at other locations in the plant. Each employe should become familiar with the identification scheme and especially with those colors which are used on pipes carrying flammable materials. We have found it desirable to post bulletins throughout the plant, showing the colors which identify each pigment number.

As the flammable liquids and gases which pass through the pump house are heavier than air, adequate ventilation at the floor level should be furnished. Such ventilation is also necessary in other buildings or rooms where these materials are pumped or used.

All electrical equipment should be of explosion-proof type and maintained properly. As in other areas throughout the plant, housekeeping of the highest type is most essential in this transfer pump house. Oily rags should be placed in closed metal containers and picked up daily. Materials spilled on the floor should be cleaned up promptly. Any extraneous materials or equipment in the building should be promptly removed to a previously provided storage space or place of disposal.

The pumps and compressors in this building are usually provided with relief valves on the discharge side to relieve excessive pressure to the suction side of the equipment. They should be checked periodically to insure their

proper functioning, thus preventing an excessive pressure from being built up in the discharge line.

As there are caustic circulation pumps in this pump house and as the caustic purification units are usually adjacent to the pump house, it is desirable to have at least one emergency shower and eye fountain in the building.

Purified butadiene and the other raw materials are next pumped through meters to determine accurate amounts for the batches. The room housing these meters is a hazardous area and should be properly ventilated at the floor level to prevent an excessive amount of vapors from being present.

Next, the butadiene and the styrene are placed in the polymerizers together with an emulsion, a catalyst, and a modifying agent. These polymerizers are equipped with combination relief valves and safety discs. The safety disc prevents the relief valve from becoming gummed-up by the materials in the vessels. A pressure gauge should be used between the rupture disc and the relief valve to detect any leak in the disc. The vent line from these combination relief valves and discs runs into a "knock out" tank, in which liquids are trapped, letting the vapors continue on to the butadiene burning stack. It is necessary to make sure that the valve arrangement to this tank is properly set up to furnish the relief necessary. Wire seals on such valve controls may be desirable.

As in other hazardous areas, all electrical equipment should be of explosion-proof type and all vessels, lines, etc. should be properly grounded.

High Pressure Is Factor

Under ordinary operating conditions, the highest pressures found in the entire process are present during the polymerization. Safe operation is exceedingly important here.

The process which follows the polymerization is the recovery operation in which unreacted materials are recovered and used again. It is essential that the vessels in this process be provided with adequate relief valves. All enclosed sections of the recovery building should have good ventilation and all electrical equipment should be of explosion-proof type.

The stripped latex is then coagulated into solid particles of rubber. The coagulation of the latex involves no safety problem other than that connected with the use of a dilute acid in one of the coagulating methods. It is necessary, of course, properly to guard transmission equipment and provide emergency stops on any rolls through which the rubber passes. Once the coagulation process is completed and the rubber is formed into small particles, the drying operation starts. This operation calls for good ventilation inside the dryers and the prevention of vapors from passing through openings in the dryer enclosures to the areas surrounding them.

Frequent cleaning of the dryers and adequate control of temperatures will aid greatly in the prevention of dryer fires. The ventilating ducts from the dryers themselves should be checked frequently to determine if there is any excess accumulation of materials in them.

Once the rubber is dried, it is then baled into 75-lb. bales. If a hydraulic baler is used, the shear point should be properly enclosed, so that there is just enough room for the bale to be discharged from the baler. Should mechanical balers be used, moving parts should be adequately enclosed and locks on the hoppers should be properly maintained.

After the rubber is baled, it is placed in cardboard boxes or paper bags and shipped. Employes handling rubber on skids should wear safety shoes and be instructed in the proper method of lifting. Rubber on skids, as well as in storage, should not be piled too high. Adequate aisle space in the rubber storage building is essential.

It can be said that the Rubber Reserve plants contain adequate safety features to make for safe operation. Nevertheless, the equipment will not function, as designed, if it is not properly maintained. This is especially true of relief valves and rupture discs which are vital to the safe operation of the plant. Defective relief devices and those that are of inadequate size are responsible for most cases of equipment failure. Some important points to be considered with regard to relief devices are as follows:

Precautions for Relief Valves

1. The discharge pipe on relief devices should be installed to prevent the accumulation of ice, water, dirt, etc.

2. Relief devices should be installed at the highest point in the vapor space in the vessel.

Automatic control of many operations from a central control room is an additional safety feature in the new synthetic rubber plants

3. Any shut-off valves installed before or after the relief devices, must be sealed open and inspected regularly to prevent them from being closed.

4. Back pressure on the discharge side of the relief devices should be low, if present at all.

Periodic inspections and maintenance of relief devices are essential to their proper functioning. It is necessary that a record be kept showing the date and conditions found at the time of the inspection of each relief valve. All maintenance work on such equipment should be performed by personnel who are skilled in this type of work. Otherwise, rupture discs will not be properly installed and tests made of relief devices will not be correctly carried out.

A procedure that can be followed in testing relief valves is as follows: (1) The valves should be tested for the opening and reseating pressures. (2) There should be a test for leakage at a pressure slightly over the operating pressure. If found to be satisfactory in both of these points, the valve may be returned to service.

Valves requiring maintenance should be cleaned and the face reground, using a water soluble valve-grinding compound. Following the cleaning, regrinding, and assembling operation, the valve should be tested for leak-tight pressure at a pressure slightly below the opening pressure.

When the set pressure of a relief valve is changed, a new name plate should be attached showing the new pressure. The set pressure of the valve should never be increased more than 10% above the designed working pressure of the equipment. It is desirable to show, in addition to the set pressure, the actual free discharge area of the relief valve in square inches.

Safety relief devices should be so arranged that the possibility of tampering will be minimized. If pressure setting or adjustment is external, the relief valve should be provided with an approved means of sealing the adjustment.

No relief device should go for a period of more than a year without being inspected. Another important point to be considered with relation to relief devices is that they should not be interchanged unless they are of the same type and size.

Safety in Styrene Production*

By H. K. Eckert**

The styrene plant has the usual safety problems found in the chemical industry, plus a number of those common to the refining of petroleum.

Among the most common chemicals used in our plant are: propane, ethylene, natural gasoline, muriatic acid, anhydrous hydrogen chloride, sulfuric acid, aluminum chloride, caustic soda, ethyl benzene, and styrene.

In addition to these, there are a number of intermediates which include mixtures of the above chemicals in varying proportions. Safe handling of most of these chemicals is well known throughout the chemical and petroleum industry. It was just a question of teaching the men who had never worked in either of these industries how to work safely with these chemicals.

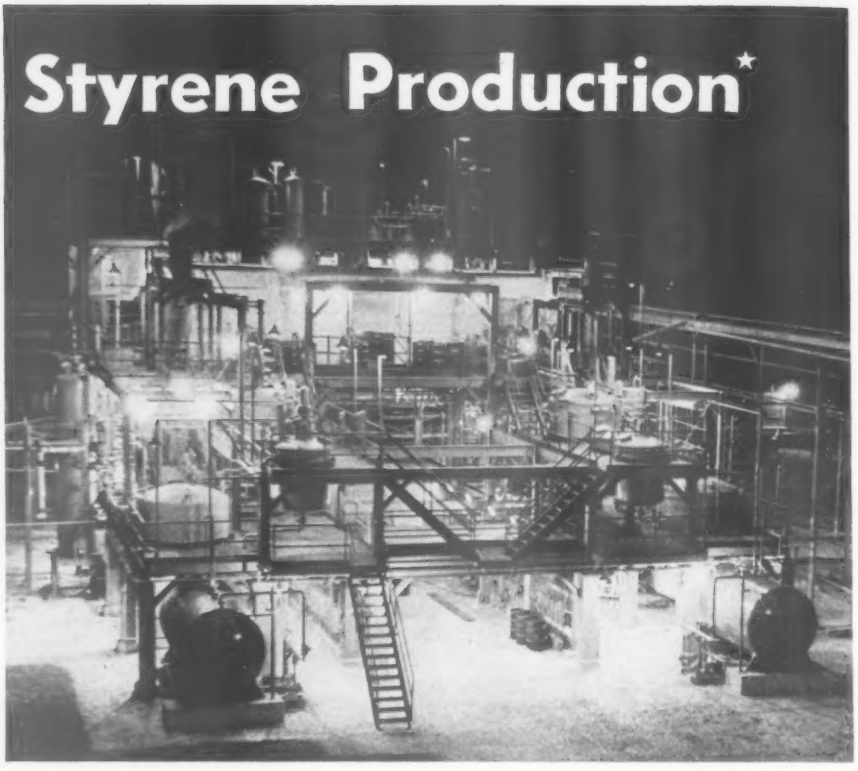
The one material upon which little information was available, is styrene. Styrene is a colorless liquid with a boiling point of 145°C. It has a peculiar gassy odor which provides ample warning of toxic concentration. It does not seem to produce the blood damage so characteristic of benzol and other ring compounds, which styrene closely resembles in structure. In a series of several hundred periodic examinations of workers, no damage was found.

Nose Irritation a Warning

The principal toxic action of styrene seems to be that of irritation of the lungs upon inhalation, and of the skin upon contact. Also, to be considered, is the fact that light narcosis may be produced by inhaling small amounts of styrene, as with other aromatic hydrocarbons. Following exposure to high concentrations of styrene, with the accompanying respiratory track irritation, there may also be liver and kidney damage.

The eye and nose irritation produced by styrene serves as a warning against hazardous concentrations. As a result of animal experimentation, a tentative permissible limit of 400 parts per million has been suggested. There is a possibility that this limit may be too high to prevent skin irritation in the workmen. Two hundred parts per million is a preferable figure. At this concentration, a disagreeable odor is present but eye and nose irritations should not be produced. It is believed that no serious health hazard should result in the case of repeated exposures to this concentration.

The styrene plant at Texas City is so built that such concentrations are almost impossible to obtain. The entire plant is outdoors, with only the closed control houses inside the area where styrene is present. These control houses are built and ventilated so that a positive pressure is maintained inside which does not allow the entrance of any vapors from the outside. Thus, if a spill occurs out in the manufacturing area, the men are not exposed to these in a closed room and the vapors on the outside are soon dissipated beyond dangerous concentration. This has aided greatly in preventing accidents from inhaling fumes from styrene. This same arrangement also prevents toxic action from benzol, which is present in as large quantities, or larger, than styrene. The absence of closed rooms where these organic vapors may concentrate has done much to make the plant safe from accidents due to inhaling toxic vapors.



In the ethyl benzene alkylation unit, at the styrene plant of Monsanto Chemical Co. at Texas City, Texas, the only enclosed buildings are the control houses, in order to eliminate possibilities for hazardous concentrations of toxic vapors. In the ventilation of control houses positive pressure is maintained so that outside vapors cannot enter. Safety requirements were a predominant factor in design and construction throughout the entire plant

Safety Showers Handy

All of the chemicals listed have a distinctly corrosive action upon the skin, if they come in contact with it in even small quantities. A number of safety devices have been installed throughout the plant to handle accidents of this kind. All areas are equipped with safety showers, placed at convenient points, so that anyone can immediately wash off materials spilled on his clothes or skin with large quantities of water. Eye baths are located throughout the plant, to serve as a source of water for any chemical in the eye or small amount of chemical which has come in contact with the skin at other places.

If by chance a person's clothes catch on fire, blankets are placed in all areas, to be used to wrap the person in and extinguish such fires. Safety equipment, such as goggles, respirators, hard hats, rubber gloves, and rubber suits, are furnished to the men wherever necessary, to prevent their coming in contact with the chemicals with consequent bad results. Mechanical guards have been placed on all machinery and equipment, so as to remove the possibility of coming into contact with any moving part of any piece of equipment.

The plant is equipped with a medical department consisting of an up-to-date dispensary with a registered nurse in charge and trained first aid attendants on duty 24 hours a day, 7 days a week. Every employe is urged to report to the nurse whenever any injury is sustained, no matter how small. A complete record of all such injuries is kept and reviewed daily by the Safety Engineer.

First Aid Training Given

First aid training is given to as many people in the plant as possible. This not only instructs them as to what they can do when a fellow employe is injured, but also makes them aware of the consequences of accidents. This we believe makes a person more safety conscious than any other single thing which can be done.

Employes' safety meetings are held once a week. They are attended by all employes on the day shift and the meeting is conducted by the safety engineer.

*A portion of a paper under this title presented before Petroleum Section, National Safety Council, Chicago, Oct. 6, 1943.

**Plant Manager, Monsanto Chemical Co., Texas City, Tex.

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Safety in the Operation Of HF Alkylation Plants*

By Roy Benson**

New safety precautions are required in the design and operation of HF alkylation plants because of the nature of the anhydrous hydrogen fluoride used as a catalyst. Mechanical features have been incorporated in plant design to minimize accidental discharge of acid to the atmosphere. These include locating the acid-carrying equipment in a pit provided with the means for neutralizing any escaping acid, and exhauster systems for removing and neutralizing acid or vapors from sections opened for repairs or other purposes. Special types of neoprene or rubber clothing are provided for various classes of work and precautions taken to prevent injury to workmen exposed to contact with the acid. First aid treatment is described.

THE demand of our flying forces for a superior fuel having exceptional power for short-run takeoffs and for long-range bombing has proved a stimulus to the use of new tools—called catalysts—by the refining industry. These new tools present new problems to the safety engineer.

Anhydrous hydrogen fluoride (HF), is a catalyst widely employed in the production of alkylate, a major component of 100-octane aviation fuel. It is a colorless liquid which boils at 66.7°F. When exposed to the atmosphere, it fumes or vaporizes strongly and, because of its high affinity for water, it readily combines with the moisture of the air. The acid vapor thus formed looks very much like steam. Its presence in the atmosphere can be readily detected by its strong, pungent odor and irritant property.

Like high-temperature oil or vapor, HF is harmless when kept within the confines of the processing equipment. Oil or vapor at high temperature causes a thermal burn on anyone exposed to it, while HF produces a chemical burn. New measures, therefore, must be adopted and rigidly enforced to protect the personnel of plants employing HF. Methods of first aid and of medical treatment must be learned in order to care for injuries incurred through the failure to observe or to enforce the rules and regulations that govern the safe use and handling of this acid. Reliance must be placed upon the designer to provide the best available equipment for the HF alkylation plant and to incorporate features which will minimize accidental discharge of acid to the atmosphere.

The operating management must be thoroughly impressed with the toxic and corrosive nature of hydrogen fluoride to the extent that the safety engineer will be given a free hand in providing the necessary protective equipment, first-aid supplies, instructional data, and authority to demand and enforce adherence to all rules and regulations for safety. Plant supervisors must be 100% co-operative with the safety department and, in fact, should bear the responsibility for the safe operation of the plant. The insidiousness of HF permits of no relaxation of intelligent supervision. Safe performance on the part of the operators, maintenance men, and others employed on the HF plant is essential; it will be obtained if they are adequately informed regarding the nature of HF and the proper manner of handling it. There should then be no need for cajoling or coercing to obtain compliance with rules and regulations for safety.

The subject of safety in the alkylation plant may be considered from the following angles:

1. Measures incorporated in the plant design.
2. Protective devices auxiliary to the design.
3. Protective wearing apparel.
4. First-aid treatment of HF injuries.
5. Medical treatment of HF injuries.
6. Physical examinations of HF plant workers.
7. General precautions.

Many problems confronted the engineers in designing an HF alkylation plant. But regardless of assurances that the acid will stay in the processing equipment, the safety man must be wary, for the human element factor cannot be overlooked. The designers, likewise, have adopted this attitude. Provisions, therefore, have been incorporated in the design to minimize the hazard of accidental release of acid to the atmosphere.

An exhauster system is provided with connections to all parts of the acid section of the plant where predictions might indicate the presence of acid on opening or disconnecting for adjustments, repairs, replacements, or sampling. This system also permits the removal of HF vapors from vessels and piping during shutdown for cleansing and inspection. HF is particularly adaptable to removal by evacuation, because of its relatively low boiling point.

The exhauster system discharges to a caustic wash tower for neutralization of HF vapors before release to the atmosphere. The exhaust release is located away from the plant area, so that in case of failure of the caustic system, the hazard to persons in the plant area will be minimized.

Quick neutralization and disposal are necessary when there are accidental spills of acid in the plant area caused by failure to evacuate properly; by failure of the seals on pumps, contactors, or valves; by rupture of lines or vessels; or by any other untoward incident. For this purpose, the acid-carrying equipment is located in a pit containing a 2-ft. depth of limestone, with the pit wall extending about 18 ins. above the base level to serve as a retaining wall. This wall or curb serves also as a boundary for the restricted acid area. The limestone neutralizes the acid which it contacts so that its spread to the surrounding area is avoided; and contamination by seepage of water through the soil is prevented, as well as corrosion of underground piping and foundation work.

Limestone that has reacted with the acid is removed and new limestone is laid down after the area is thoroughly washed with water. The spent limestone is deposited in an isolated location away from any processing equipment, where it is allowed to hydrolyze slowly.

An auxiliary limestone pit is provided outside the acid area into which water and/or acid following major spills may drain from the acid area pit for further treatment.

An acid area pit which does not contain limestone may also be used. In this case water washing is done immediately following the spills; and dilute acid solution is then neutralized in an auxiliary pit containing limewater, and the acid is precipitated out. The precipitate is subsequently removed and buried, the liquid being discharged through the sewer after it becomes neutral. (See Fig. 1.)

Disposal of spent acid should receive continued attention so as to avoid contamination of drinking water and pollution of rivers and streams.

The possibility of accidental discharge of acid presents a hazard to the personnel. For the prevention of injury to those exposed to acid contact by accidental discharges, emergency shower and first-aid booths must be provided in order that immediate first-aid measures can be taken. The showers should be operated by treadles so that both hands may be free for removal of clothing. Warm water should be available in winter weather to avoid sudden shock, which may aggravate a similar condition caused by the acid burn itself. The booths should contain bubbler fountains for effective flushing in the treatment of eye injuries. They should also be equipped with the necessary first-aid

*Presented before Petroleum Section, National Safety Council, Chicago, Oct. 6, 1943.

**Safety Engineer, Research and Development Laboratories, Universal Oil Products Co., Riverside, Ill.

medicaments and other supplies which will be discussed later.

In order that exposure may be minimized when work must be performed at or near leaks of acid, portable air movers are helpful to create a windward side when the atmosphere would otherwise be still. Obviously workmen should always station themselves on the windward side to avoid blow of acid toward themselves. Compressed air may be used in lieu of portable air movers, provided sufficient capacity and properly designed nozzles are available.

For rescue work or other duties in an atmosphere that is heavily laden with HF vapors, a complete coverage, air-supplied suit is necessary. For the air supply the acid area should be encircled with an air line with quick attachment hose connections spaced at close intervals. (See Fig. 2.)

Burns resulting from the handling of tools that have been used where acid may have contacted them are avoided by placing receptacles containing sodium bicarbonate at locations convenient for neutralization and removal of any acid film. All tools must be doused in the solution promptly after use and before they are returned to the toolroom. This precaution is a protection primarily to those who may use or handle tools after they have been taken from the acid area where workmen would normally wear acid-proof gloves.

The pit wall mentioned previously constitutes the boundary around what may be termed a restricted area. This wall should be painted a distinctive color, preferably red, and plainly marked at fairly close intervals with signs reading 'Restricted Area—Do Not Enter Without Permission.' Delegated persons should be granted the authority of giving this permission. The requirement of permission, of course need not apply to operators regularly assigned to the HF alkylation plant, but it should apply to all others, including maintenance and repair workers. Those granting permission should learn the purpose of each request and then stipulate the type of protective apparel which must be worn. Supervisors and operators should watch the workers in the area, and report any infractions of rules pertaining to the wearing of protective apparel and the performance of duty.

Various types of jobs in the acid area requiring specific protective wearing apparel may be classified as follows:

A, routine operations.
B, plant alterations.
C, maintenance.
D, emergency or hazardous work.

Protective apparel recommended for the various classes of work is as follows:

Class A Apparel

Class A clothing, which consists of neoprene-soled work shoes, rubber cap, wide-angle face shield, and neoprene gauntlet gloves, is worn only when making a visual observation of the plant under normal conditions. Any person entering the acid area must wear this equipment. His gloves must be on and his face shield down when he crosses the restricted-area boundary line. The shoes protect his feet against acid that may have condensed on the ground or on the stairways, platforms, and runways. The cap offers protection against acid dropping from above. The gloves are extremely essential, because any surface touched may have an acid film; or in performance of various duties there may be slight discharges of acid vapor, which may come into contact with the unprotected hands by way of tools and other objects handled. The wide-angle feature of the face shield is a protection also to the ears.

Class B Apparel

When changes are to be made in plant operation, Class B clothing should be worn. This includes a rubber or neoprene acid-proof coat, together with the Class A apparel mentioned above; i.e., neoprene-soled work shoes, rubber cap, face shield, and neoprene gauntlet gloves. The purpose of the coat is to provide protection for the arms and body of the workman. The possibility of pump and packing failures, for instance, when making adjustments to operating conditions, prompts this recommendation for additional protection.

Class C Apparel

Clothing of this classification is recommended whenever acid equipment is to be opened up for inspection or repair. Rubber boots and neoprene acid-proof garments, which include a coat, overalls, gauntlet gloves, and a hood, are worn. Rubber apparel may be substituted if neoprene is not available. Class C clothing protects the wearer against the discharge of acid or acid vapor which may not have been previously drained or evacuated from the inside surface of the equipment.

Class D Apparel

This class of protective apparel has been specifically designed for work in acid vapor atmospheres where complete protection might be needed, as in the case of repairing an extremely large leak, or of working where the concentration is higher than that which could be handled by a canister mask. The clothing consists of a neoprene coverall suit provided to admit compressed fresh-air supply to the body as well as the headpiece. Through the admission of air to the body portion, the wearer is enabled to move about in comfort; in addition, the air prevents acid vapor from entering the suit because of the air passing out. The constant rush of air blowing out around the neck and other openings makes it possible for the wearer to work safely in any concentration of acid vapor-air mixtures. This feature also is a safeguard in case the suit is torn.

The air supply for this suit is taken off the air line referred to previously as having been installed for that purpose. Operators and others should be required to practice donning the suit so that there will be no loss of time when an occasion arises to wear it. The alkylation plant should be provided with a large and a small suit, and both suits should be readily available at all times and regularly examined for condition.

Safety apparel should be thoroughly washed with water before it is laid away.

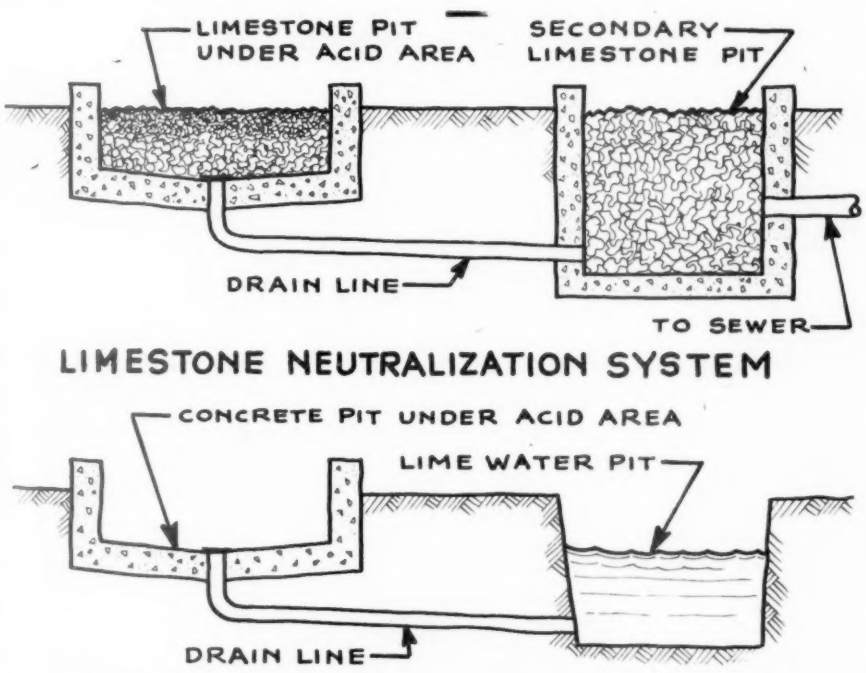

Fig. 1 (Upper)—Sketch of limestone neutralization system. (Lower)—Sketch of lime water neutralization system, in which acid-carrying equipment at HF alkylation plant is located

A suit can be conveniently washed before the wearer takes it off.

Treatment of Casualties

Although plant design, protective equipment and supervision are excellent, accidents may occur; consequently the treatment of casualties has been carefully studied, and facilities for rendering such treatment provided.

Prompt action is of the greatest importance for successful treatment. For example, when acid has come into contact with the skin, the area affected should be immediately flushed with water for at least ten minutes. The burning sensation of extremely low concentrations may not become apparent for some time after contact, particularly if the acid has touched the tough, thick skin of the hands or feet. Therefore the area should be washed even though there is only a suspicion of an acid contact. High concentrations of acid penetrate the skin rapidly and produce a stinging sensation almost immediately. The warning is sufficient to cause the worker to lose no time in starting first-aid treatment. A delayed-action burn may cause a painful, deep-seated injury that requires medical aid; therefore, splashes of all kinds should be treated for acid burns. The following first-aid treatment is recommended:

1. Flush well with water for at least ten minutes.
2. Apply, with cotton, a 10% solution of ammonia (10% of 28% aqueous ammonia solution), and rinse with water. Do not use household ammonia unless none other is available. It is preferable to use a sterile solution made by a pharmacist in accordance with the U.S.P.
3. Rub well into the affected area the special magnesium oxide-glycerin HF burn salve which should be on hand in the first-aid and emergency booths. Blisters, if any, should be opened with a sterile instrument by a competent person.

With most acids, merely washing with plenty of water and neutralizing, if done quickly enough, are sufficient to stop their action. HF, however, has a double action on the skin: first, there is the acid, which must be neutralized; second, there is the fluorine ion, which must be precipitated. Therefore, it is necessary not only to wash the area thoroughly and apply ammonia, but also to use magnesium or calcium in a form that will precipitate the fluorine ion. If there is delay in treatment, or neglect, HF penetrates deeply into the tissues and causes deep-seated burns, compared by one authority to those produced by high-voltage electricity. Blisters are opened so that the salve will reach the acid underneath and stop its action quicker. If the acid has penetrated into the tissue, the magnesium oxide paste applications will not be sufficient to prevent a bad burn, and it will be necessary to obtain medical aid for the injection of 10% calcium gluconate or 20% magnesium sulfate by hypodermic around and under the affected area. This application will form a calcium or magnesium barrier around the burn and prevent further destruction.

Some of the most painful burns experienced have been under the fingernails. Some physiologists believe that the acid penetrates the nail itself, and when under the nail, starts its destruction of tissue in a particularly tender spot. If the calcium gluconate or magnesium sulfate can be injected through the nail or around it, the pain may be alleviated.

Water Wash Favored

The above treatment is not the only one advocated by manufacturers of hydrogen fluoride. A number of authorities favor prolonged washing with water to draw the acid from the tissue by osmotic action. One worker with HF recommends prolonged washing followed by ice-cold alcohol immersion. Even the most painful burn can be rendered almost painless by holding the affected part in ice-water but when it is withdrawn from the ice-water, the pain may commence again.

It is almost impossible for anyone consciously to inhale enough hydrogen fluoride to harm himself seriously: the acid gas is too pungent for voluntary inhalation. Study of the available literature on this subject showed only one case of a fatality from HF inhalation. The possibility of being rendered unconscious and becoming injured appears to exist only if a man is trapped where gases are suddenly released. Should this occur, the following procedure is recommended:

1. Remove the patient to fresh air, free from drafts.
2. Treat skin burns by the prescribed treatment.
3. Make patient rest.
4. Reassure the patient and discourage him from coughing. Cough syrup should be provided in each shower house.
5. Apply artificial respiration if necessary.
6. Keep the patient warm, because he will be suffering from shock.
7. Call the doctor on all inhalation cases.

Eye injuries among workers handling HF have been rare; strict adherence to eye protection is apparently the reason. Nevertheless, bubbler fountains should be installed in each shower house for flushing and washing the eyes in case of injury. Bottles containing a saline solution should also be available for neutralization. Beyond the administering of water and saline solution medical aid should be sought.

In view of the heretofore limited use of hydrogen fluoride and consequent lack of knowledge or widespread information regarding the treatment of HF casualties, a booklet on the subject was prepared by Anton J. Carlson, noted physiologist of the University of Chicago, for distribution to medical men located in the vicinities of the HF alkylation plants. Copies of this booklet, Treatment of Hydrofluoric Acid Casualties, may be secured from the Universal Oil Products Co. Managements of plants have been requested to place the booklet in the hands of their industrial doctors and nurses.

No Fluorosis Found

Whenever the subject of fluorine or fluorine compounds is mentioned, the work of Roholm on cryolite workers in Denmark comes to the fore. Roholm found that these men, who inhaled fluorine-bearing dusts over a period of many years, incurred what he called

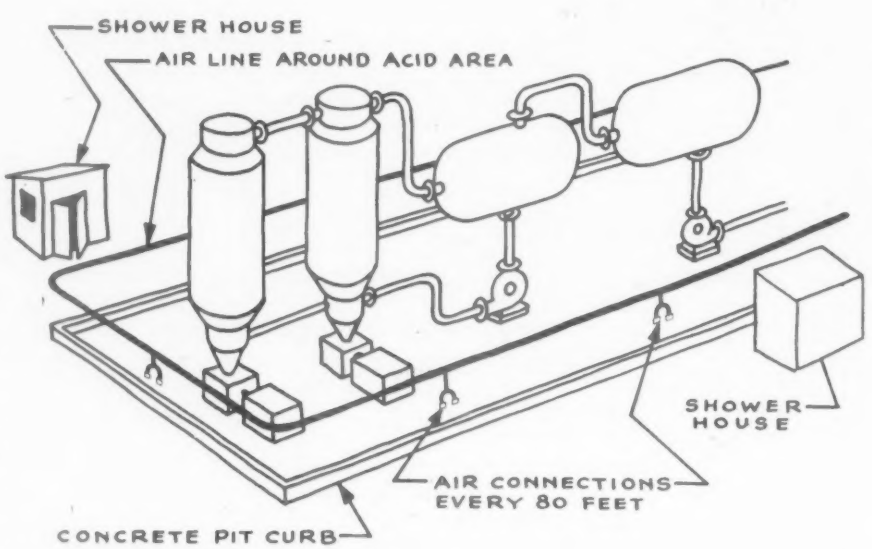

Fig. 2—Sketch of HF alkylation contactor section, showing location of shower house, emergency air lines and curb of concrete pit for neutralization system

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"fluorosis." After years of work the men became slightly stooped, and their backs stiffened. X-ray examinations disclosed that their backbones and pelvic bones had increased in size, and posthumous examinations showed a surplus of fluorine.

When hydrogen fluoride was proposed as a catalyst, the records of workers in plants where this material was made were investigated for evidence of fluorosis. One of the plants had been taking X-rays of its men every year, but found no cases of fluorosis. Another plant making HF for more than ten years had all of its men X-rayed, but none had any evidence of fluorosis. One HF manufacturer had been giving his men physical checkups for more than five years without ever detecting any sign of the disease.

The men working in alkylation plants have even less chance of contacting fluorine than those in the acid-manufacturing plants as the alkylation equipment is all outside while the hydrofluoric acid retorts are all inside. However, our men are always examined before they are assigned to HF alkylation plant operation. If there are any abnormal bone or joint conditions, the men are eliminated from further consideration. X-ray examinations will be repeated annually for confirmation of our present belief that a worker in normally good health, when assigned to HF alkylation plant operation, needs have nothing to fear regarding any ill effects as a result of this employment.

In addition to the X-ray tests we advise pre-employment analysis of the urine for fluorine content. From work done by Machle and Largent, of Kettering Institute in Cincinnati, it has been established that the fluorine content of the urine is an indication of the fluorine intake of the individual. If the normal content is known, then a check analysis every six months will show any amount absorbed. Arrangements have been made with Kettering Institute to analyze the samples. We believe these tests will prove to HF alkylation plant personnel that there is no fluorine intake as a consequence of their employment.

General Precautions

For the purpose of detecting leaks which may cause contamination of cooling water with HF, a pH recorder is employed on the water outlet from the plant. The leakage of acid into the water system, or vice versa, would present a serious problem of corrosion. Contamination of water in streams or rivers into which waste water from the plant is discharged might cause complaints on the part of public health agencies and fish and game authorities. Only through carelessness and lack of attention, however, would this eventuality arise.

Spent bauxite from the bauxite treaters, contaminated limestone from the neutralizing pit, precipitated calcium fluoride, or waste materials which cannot be easily and completely decontaminated must be disposed of in a safe manner and in a place where they will not constitute either a hazard or a nuisance. These materials should be dumped into a pit over the bottom of which has been placed a layer of lime. Lime should also be spread on top of the dumped material so that any free fluorine remaining in it will be converted to stable calcium fluoride. Flammable materials which may contain HF should be burned.

Identification of all piping in which there is or may be hydrogen fluoride should be in accordance with the color scheme of the A.S.A. Code. This code stipulates yellow as the color for hazardous materials. Lines containing other materials are to be painted in accordance with the respective colors specified.

Acid spills on floors, stairways, and platforms should be immediately neutralized with soda ash. Small pans containing this chemical should be provided to catch drippings.

All equipment which has been in acid service should be thoroughly neutralized before it is turned over to shop or warehouse, or placed elsewhere for subsequent disposal where it may be handled with the bare hands. A strong soda ash solution is recommended as a neutralizer. Shop repair and maintenance men, warehouse men, and others should be warned of the danger of HF so that they will be on the alert for any indication of acid.

Traffic through the acid area should be confined to the men whose duties require it. All others should walk around the area.

Whenever possible, workmen should station themselves on the windward side when making valve adjustments, taking up packing on pumps, lubricating cocks, or tightening flanges. In case of serious leaks requiring exit from the immediate area, workmen should retreat in the windward direction.

There should be no relaxation in compliance with rules and regulations pertaining to the use and handling of hydrogen fluoride.

What the SAFE Dressed Man Will Wear in HF Alkylation Plant

Class A | Class B | Class C | Class D

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Special Ventilation Provided Where Solvents are Used

THE importance of proper ventilation in rubber processing and converting and finishing operations, as well as in other modern industrial plants using solvents, was emphasized in a paper by B. Offen, of B. Offen & Co., Chicago engineering firm, before the special session on new manufacturing processes of the Rubber Section of the National Safety Council in Chicago Oct. 6. Title of his paper was "Ventilating Problems in the Rubber Industry."

"In many of the processes today solvents are an integral part," he stated. "New products of all descriptions are being developed and many of these require large volumes of solvents in their processing. In some cases solvents may be handled several times, thus adding to the ventilation problem." In discussing ventilation for the section of the plant where the solvent is mixed or otherwise prepared for further use he said:

"In many cases, the mixers have open tops and frequently are driven through line shafts and belting. In layout of this type it is important to maintain large volumes of exhaust air because the solvents are not confined. It is necessary to place the exhaust ducts between the wall and the mixers, locating the openings near the floor as well as near the top of the mixers.

Hooded Mixers Desirable

"Wherever possible the top of the mixer should be hooded and connected to the exhaust system. The exhaust system should be of sufficient capacity to give the mixing room an air change approximately every 3 to 5 minutes, depending on the working space and the volume of vapors liberated. Where mixers are covered the air condition naturally will be better; however, good exhaust should be maintained since losses will take place in handling the solvents.

"It is further desirable to replace this exhaust air with fresh air, especially where rooms are separated by fire walls. The use of open windows is common but through the winter season window ventilation is not desirable. Further fresh air brought into the room should be distributed so as not to spread the solvent fumes throughout the area. Fresh air brought into the room should be discharged toward the working area, thus giving workers the benefit of the fresh air before it is drawn toward the mixers to be exhausted."

It is important to provide sufficient ventilation for the various types of processing machines, the paper brought out, since in most cases drying apparatus is used to hasten the liberation of the solvent and the drying of the product. Where possible the entire machine should be enclosed, or if physical conditions make this impossible, the more critical parts should be hooded.

Fire hazards where solvent vapors are created require special attention, the paper brought out, particularly where dust is also present in the atmosphere. Pressure vessels, exploding because of mechanical defects, may give off a spark in rupturing, due to contact between parts of the vessel, thus providing ignition to a hazardous mixture. In addition, a static discharge may be liberated due to the sudden release of gas pressure, it was brought out.

In operations where concentrations of solvents exist, the areas where the solvents are handled should be confined as much as possible and the entire surrounding area should be thoroughly ventilated so that under no condition will an explosive mixture exist near the machine where the solvent vapors are being liberated. Under these conditions, should a fire develop in the highly concentrated area, it can be isolated, thus preventing a serious explosion and the propagation of a fire.

Purge Air at Machines

"In many plants, solvents are handled by mechanical means," it was stated. "In these areas exhaust should be provided because of losses in the stuffing glands, loose pipe connections and occasional repairs to machinery. It is necessary to rid these machines of all solvent vapors before making repairs. While it is difficult to prevent some diffusion of solvent vapors, if most of the solvent and dust is trapped at the source and exhausted with sufficient volumes of air, reasonable safe working conditions will exist."

Since, in industrial operations of this type it has been found difficult to prevent the development of static electricity, it is necessary to arrange for its maximum dissipation so as to prevent a static spark. "All parts of the machinery should be thoroughly grounded except the moving parts. Brushes of a satisfactory design should contact all shafts; static bars of an approved design should be located near the processed material for desired leakage of the static charge and, in addition, static bars should be located near rope or belt drive, for these frequently develop rather high static charges.

"In grounding machinery, heavy wire is recommended and connections should be made to either a wet sprinkler or a water main running into the ground. If these pipelines are not handy, then a direct wire to the ground will do. Overcaution is advised, since grounding of machinery is not expensive and requires practically no maintenance, once installed."

Few Dermatitis Cases In Rubber Plants

The manufacture of synthetic rubber occasionally causes dermatitis among workers, due largely to the exposure to various chemicals, particularly styrene, Dr. W. E. Obetz, of the Division of Safety and Hygiene, Industrial Commission of Ohio, told the Rubber Section of the National Safety Council, meeting Oct. 6 to discuss safety precautions in the new synthetic rubber plants.

The dermatitis usually occurs on the exposed surfaces of the body, causing little disability and responding to the usual treatment for mild cases, said Dr. Obetz. His conclusions were based on claims filed with the commission, originating for the most part in the rubber plants in Akron.

"The cases which have come to our attention indicate that chemists, laboratory helpers, maintenance men, janitors and laborers occasionally develop dermatitis from contact," he stated. "Chemists and laboratory helpers are no doubt exposed during their research work. Maintenance and repair men are required to repair broken parts where leaks occur. Janitors are exposed to dust, vapors and liquids in process of cleaning. Even those who handle slabs of the finished product occasionally develop mild dermatitis."

The number of cases that have developed is small considering the number of persons engaged in the plants, Dr. Obetz reported. "This small exposure is probably due to the fact that much of the process, as far as the conveying and mixing of chemicals is concerned, is entirely enclosed in a network of tanks, pipelines and similar equipment," he stated. "From the tank car until coagulation has been accomplished the process is almost entirely enclosed and the chances for exposure occur only when there is a leak in some pipeline, a defective valve or disabled pump. After coagulation takes place the washing, drying and pressing operations provide opportunities for exposure, especially to fumes thus liberated."

From the causes given in claims filed, styrene is most frequently mentioned of the chemicals used, it was stated, and it is considered more irritant to the skin and more apt to cause dermatitis.

Preventive measures were said to be similar to those for other skin diseases caused by contact with chemicals. The most essential precaution is to avoid contact with liquids, fumes, vapors and dust encountered in handling the materials. Use of protective clothing such as gloves, sleeves, aprons and hand creams is recommended. Personal cleanliness in the frequent and careful removing of all irritating substances from the skin is also essential.

Stress Analysis of Tall Towers

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734.5

Four Methods Are Compared for Calculating Stresses and Required Shell Thicknesses for Vessels of Dimensions Used in Modern Refineries

By E. F. Brummerstedt*

Introduction

This article describes four different methods of calculating stresses and thicknesses of bottom shell sections of tall fractionating towers designed for high winds or seismic forces. It is hoped that this analysis will arouse helpful discussion relative to the best theory. The A.P.I.-A.S.M.E. Code for Unfired Pressure Vessels does not provide a method for the determination of thicknesses under these stress conditions, although it requests that the forces discussed are included in stress calculations. (Paragraphs W-305, Loadings, and W-306, Allowable Working Stress.)

The trend toward close fractionation in refinery design recently has been to tall towers, some with as many as 70 bubble trays spaced at 2-ft. intervals, which, together with top vapor space and bottom reservoir, has resulted in towers in excess of 150 ft. in height. The bottom shell of these towers is subjected to a combination of stresses, which are difficult to reproduce in a model for testing purposes. Consequently there has been a considerable difference of opinion among engineers as to the best method of calculating the resulting stresses and corresponding required thicknesses. Each of the 4 predominant theories of strength and its application toward a typical problem is hereby discussed.

The Problem

It is desired to analyze the stresses in a 70-tray fractionating tower 10′ 0″ I.D x 160′ high designed to withstand an internal pressure of 200 psi. and a horizontal seismic force of 20% of its operating weight applied at the center of gravity. (This latter requirement was imposed by local law; in this particular case it is more severe than the customary 30 lb./sq.ft. wind load for 100 mph. wind.)

The tower is designed in accordance with A.P.I.-A.S.M.E. Code, and hence the maximum stress must not exceed 13,750 psi. times the joint efficiency. Using A.S.T.M.-A-70 flange quality plate and stress-relieving the vessel, the joint efficiency is 82%. Hence, the allowable stress = 13,750 x .82 = 11,300 psi.

The operating weight, based on estimated thicknesses established by calculations, and including all attachments, such as piping, platforms and ladder, and maximum level operating liquids, is 620,000 lbs. The seismic force is 20% of this, or 124,000 lbs., applied at the center of gravity. The seismic moment at the bottom tangent is obtained by adding the sum of all partial moments, i.e., 20% of the weight of each part multiplied by the distance from the bottom tangent to the center of gravity of that part. This total moment is 9,600,000 ft.-lb., indicating that the center of gravity is 9,600,000/124,000 = 77.5′ above the bottom tangent.

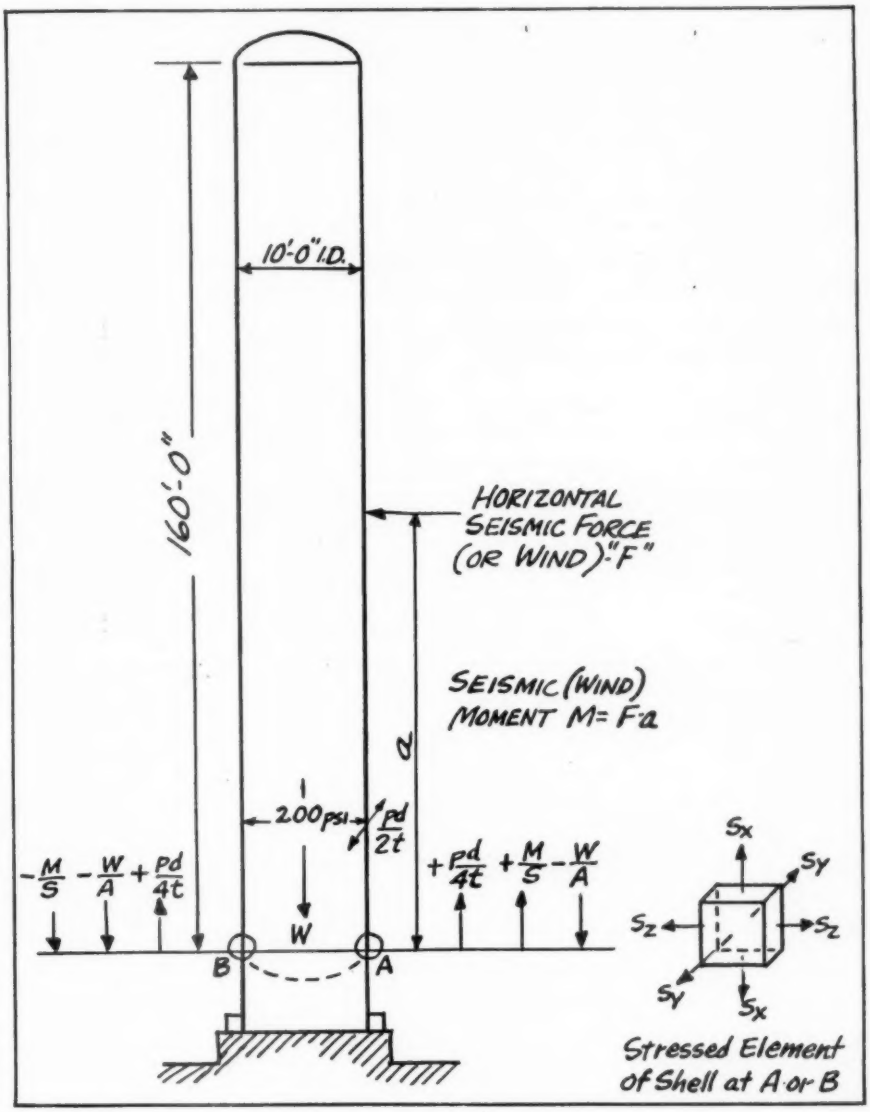


Fig. 1—Principal elements of stress in a fractionating tower shell

1. Maximum Stress Theory

Reviewing elementary theory, the general case of an element of a stressed body indicates three principal stresses, S_x, S_y and S_z, as shown in Fig. 1.

With tension positive and compression negative, assume the following relation between the algebraic values of the three stresses:

$$S_x > S_y > S_z$$

The maximum stress theory (Rankine's theory) assumes that yielding starts in an element as shown above when the maximum principle stress (or minimum) becomes equal to the yield point of the material in simple tension (or compression). The condition for yielding is thus

$$S_x = S_{yp}, \text{ or } S_z = S_{yp}'$$

where S_{yp} is the yield point stress in tension and S_{yp}' the yield point stress in compression.

This is the oldest and simplest theory.

*Petroleum Refinery Division, Foster-Wheeler Corp., New York.

Since no attempt will be made in this article to decide on the relative merits of the various theories, the reader is referred to the bibliography listed below for comments regarding its reliability. It is well-known and commonly used, however, and appears to form the basis of the present thickness formulas given in the Code.

Application

A required thickness of 1½" was assumed for the bottom section of the shell in the weight calculations. Most tower shells have an ⅛" corrosion allowance added to the required thickness to insure longer life; for the purpose of simplifying the calculations, however, no corrosion allowance will be added to this vessel. The mean diameter is then equal to the inside diameter plus the thickness, and will be denoted by d throughout the calculations. With p equal to the internal design pressure in psi, and t the thickness in inches, the circumferential tensile or hoop stress = pd/2t

$$= \frac{200 \times 121.5}{2 \times 1.5} = 8100 \text{ psi.}$$

The longitudinal tensile stress due to the internal pressure is equal to pd/4t =4050 psi, or half the circumferential pressure stress.

The longitudinal stress due to the seismic moment = ± M/S, where M = seismic moment = 9,600,444 × 12 = 115,000,000 in-lb., and S = section modulus of a thin-walled cylinder = $\pi dt^2/4$ = .785 d^2 t in in.^{3} (approx. formula).

$$\text{Then } \frac{M}{S} = \pm \frac{115{,}000{,}000}{.785 \times 121.5^2 \times 1.5}$$

$$= \pm 6650 \text{ psi.}$$

The longitudinal compression stress due to the operating weight = W/A, where W = is the operating weight and A is the cross-sectional area of the shell, or π dt. Thus

$$\frac{W}{A} = -\frac{620{,}000}{3.14 \times 121.5 \times 1.5} = -1080 \text{ psi.}$$

Then, on the side toward the seismic force, (windward side if wind moment should govern) the maximum longitudinal tensile stress = 6650 − 1080 + 4050 =9620 psi.

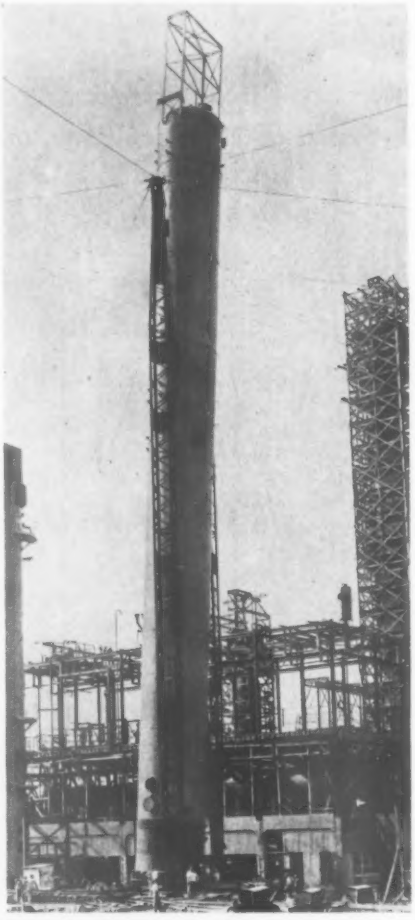
The radial stress in thin-wall cylinders is negligible and therefore assumed = 0.

Then S_x = 9620, S_y = 8100, and S_z = 0 psi.

On the side opposite the seismic force (leeward if wind moment governs) the maximum longitudinal compressive stress = − 6650 − 1080 + 4050 = − 3680 psi.

Here:
S_x = 8100, S_y = 0, and S_z = − 3680 psi.

Hence longitudinal tension on the seismic (windward) side causes the maximum



Fractionating tower being eased into position on its foundation. Hinged carriage on base moves along tracks during lifting operation. Size of tower is indicated by human figures below

stress, using this theory. When the circumferential tension does not govern, therefore, the formula for the maximum stress is

$$S_{max.} = \frac{M}{.785\ d^2 t} - \frac{W}{3.14\ d\ t} + \frac{pd}{4t}$$

Since the maximum stress of 9620 psi is considerably less than the allowable stress of 11,300 psi, the estimated thickness of 1½" is too conservative and can be reduced to 1 5/16". The small reductions in the weight and seismic moment due to this change in the bottom thickness can be ignored for the purpose of this comparative analysis.

$$\text{Then } S_{max.} = \frac{115{,}000{,}000}{.785 \times 121.3125^2 \times 1.3125}$$

$$- \frac{620{,}000}{3.14 \times 121.3125 \times 1.3125}$$

$$+ \frac{200 \times 121.3125}{4 \times 1.3125} = 11{,}000 \text{ psi.}$$

This is still within the allowable stress. The revised circumferential stress is only

$$\frac{200 \times 121.3125}{2 \times 1.3125} = 9260 \text{ psi, hence does}$$

not govern. Thicknesses in the upper parts of the tower are checked and reduced correspondingly.

II Maximum Strain Theory

This theory, commonly attributed to Saint Venant, assumes that yielding of a ductile material starts when the maximum unit strain (elongation) becomes equal to the unit strain at which yielding occurs in simple tension, or the maximum unit compressive strain becomes equal to the unit strain in simple compression.

Experiments show that axial elongation is accompanied by lateral contraction.

$$\text{This ratio, } \mu = \frac{\text{unit lateral contraction}}{\text{unit axial elongation}}$$

is known as Poisson's ratio, and is generally taken as 0.3 for steel within the elastic limit. If a steel bar is subjected to tensile forces in two perpendicular directions, the net elongation in the direction of the larger force x, will be

$$e_x = \frac{S_x}{E} - \mu \frac{S_y}{E}$$

where E = modulus of elasticity.

The condition for yielding with the above three principal stresses then becomes

$$\frac{S_x}{E} - \frac{\mu}{E}(S_y + S_z) = \frac{S_{yp}}{E}$$

or

$$\frac{S_z}{E} - \frac{\mu}{E}(S_x + S_y) = \frac{S_{yp}'}{E}$$

With the radial stress S_z equal to zero as above, the maximum stress combination ni accordance with the above formulas must be determined per $S_{max.} = S_x - \mu S_y$.

Application

As shown above, the following stresses are obtained on the basis of the estimated 1½" thickness:

Circumferential tension = 8100 psi.
Max. longitudinal " = 9620 "
" " compression = 3680 "

Then the maximum stress is the largest of the following combinations:

Seismic side,
$S_{max.} = 8100 - (.3 \times 9620) = 5214$ psi.
Opposite side,
$S_{max.} = 8100 - (-.3 \times 3680) = 9204$ psi.
or
$-3680 - (.3 \times 8100) = -6110$ psi.

In contrast to the maximum stress theory, which indicates the combined tensile stress on the seismic (windward) side as the worst condition, this theory shows the combination of circumferential tension and longitudinal compression on the opposite (leeward) side as the most

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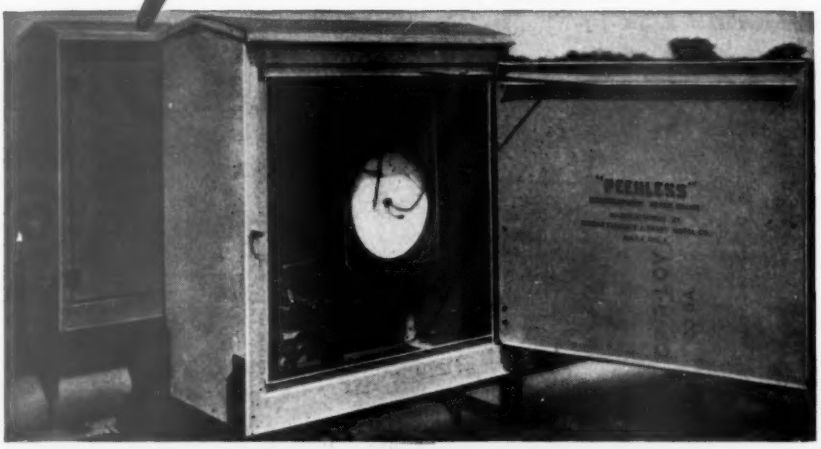

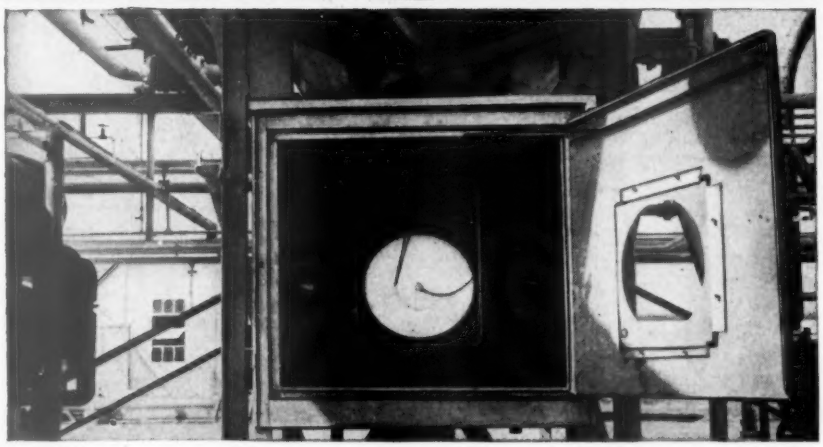

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dangerous. For this case, therefore, the formula for the maximum stress is

$$S_{max.} = \frac{pd}{2t} + .3\left(\frac{M}{.785d^2t} + \frac{W}{3.14dt} - \frac{pd}{4t}\right)$$

This formula probably will not hold for lower internal pressures; all three of the above combinations must be tried to determine the governing condition.

Since the maximum stress of 9204 psi is also considerably below the allowable, it appears that with this theory the bottom shell thickness can be reduced to 1¼". Thus

$$S_{max.} = \frac{200 \times 121.25}{2 \times 1.25} + .3\left(\frac{115{,}000{,}000}{.785 \times 121.25^2 + 1.25} + \frac{620{,}000}{3.14 \times 121.25 \times 1.25} - \frac{200 \times 121.25}{4 \times 1.25}\right) = 11{,}035 \text{ psi.}$$

This is within the allowable. The first term, giving the circumferential tension = 9700 psi, obviously does not govern.

This theory is the most optimistic of all, especially in its contention that a material subjected to bi-axial tension has a higher yield point than in simple tension. For authoritative comments regarding its conformance with experimental data, reference again is made to the bibliography.

III Maximum Shear Theory

This theory, as developed by J. J. Guest, assumes that yielding starts when the maximum shearing stress becomes equal to the maximum shearing stress at yield point in a simple tensile test. Since the maximum shearing stress is equal to half the difference between the maximum and minimum principal stresses, the condition for yielding is

$$\tfrac{1}{2}(S_x - S_z) = \tfrac{1}{2} S_{yp}.$$

For purposes of simplification and comparison with the other theories, the allowable shear stress and maximum actual shear stress will be doubled, eliminating the ½ fraction on each side of the stress equation and making it

$$S_{max.} = S_x - S_z.$$

Application

As shown above, on the seismic (windward) side the three principal stresses based on 1½" thickness are:

$S_x = 9620$, $S_y = 8100$, and $S_z = 0$.

There

$$S_{max.} = 9620 - 0 = 9620 \text{ psi.}$$

On the opposite (leeward) side, $S_x = 8100$, $S_y = 0$, and $S_z = -3680$ psi.

There

$$S_{max.} = 8100 - (-3680) = 11{,}780 \text{ psi.}$$

This is obviously the worst combination. The formula for the maximum stress using this theory, is therefore,

$$S_{max.} = \frac{pd}{2t} + \left(\frac{M}{.785d^2t} + \frac{W}{3.14dt} - \frac{pd}{4t}\right)$$

Assuming, as in this case, the parenthetical term is greater than 0,

$$S_{max.} = \frac{pd}{4t} + \frac{M}{.785d^2t} + \frac{W}{3.14dt}$$

Since the maximum stress exceeds the allowable, the shell thickness must be increased to 1 9/16".

Then

$$S_{max.} = \frac{200 \times 121.5625}{4 \times 1.5625} + \frac{115{,}000{,}000}{.785 \times 121.5625^2 \times 1.5625} + \frac{620{,}000}{314 \times 121.5625 \times 1.5625} = 11{,}200 \text{ psi.}$$

(within allowable).

This theory is obviously more conservative than the maximum stress and strain theories, since it results in a higher combined stress and consequently greater thickness. It is in good agreement with experimental data, however, and because of its simplicity of application, is generally used in machine design for ductile materials. The maximum shear theory was further developed by Mohr, whose presentation of the stress conditions in an element of a stressed body by circles may be of interest to the reader investigating strength theories in the appended literature.

IV. Modified Strain-Energy Theory

Of the many refinements and modifications to the so-called maximum strain-energy theory the most popular is the following equation for yielding developed by Huber, Hencky and von Mises:

$$(S_x - S_y)^2 + (S_y - S_z)^2 + (S_z - S_x)^2 = 2\,(S_{yp})^2$$

Unlike the maximum shear theory, this theory does not ignore the intermediate principal stress. It is obviously more cumbersome in its application, however, and despite considerable verification by experimental evidence, it is not as commonly used as the simpler maximum shear theory, which gives similar results.

Application

On the seismic (windward) side, as above, $S_x = 9620$, $S_y = 8100$, and $S_z = 0$.

$$2\,(S_{max.})^2 = (9620 - 8100)^2 + (8100 - 0)^2 + (0 - 9620)^2 = 160{,}300{,}000$$

$$S_{max.} = \sqrt{80{,}150{,}000} = 8950 \text{ psi.}$$

On the opposite (leeward) side, $S_x = 8100$, $S_y = 0$, and $S_z = -3680$ psi,

$$2(S_{max.})^2 = (8100 - 0)^2 + [0 - (-3680)]^2 + (-3680 - 8100)^2 = 217{,}000{,}000$$

$$S_{max.} = \sqrt{108{,}500{,}000} = 10{,}450 \text{ psi.}$$

This theory is apparently somewhat less conservative than the maximum shear theory, but more so than the maximum stress and strain theories.

Since the maximum stress is not quite up to the allowable, the thickness can be reduced slightly from 1½ to 1 7/16". As no simplified formula, comparable to those developed for the other theories, is practical using this theory, the principal stresses must be recalculated individually for the worst condition as found above.

S_x = circumferential tension = $\dfrac{200 \times 121.4375}{2 \times 1.4375} = 8450$ psi.

S_y = radial stress = 0

S_z = longitudinal compression = $-\dfrac{115{,}000{,}000}{.785 \times 121.4375^2 \times 1.4375} - \dfrac{620{,}000}{3.14 \times 121.4375 \times 1.4375} + 4225 = -3805$ psi.

There $2\,(S_{max.})^2 = (8450 - 0)^2 + [0 - (-8805)]^2 + (-3805 - 8450)^2 = 236{,}000{,}000.$

$$S_{max.} = \sqrt{118{,}000{,}000} = 10{,}900 \text{ psi}$$

(within allowable).

Comparison of Results

The above 4 theories are the most common at present. There are several additional modifications proposed in advanced texts on strength of materals, but for the purpose of comparative results they can be ignored. The summation of combined stress formulas and results as based on a common thickness of 1½ ins. for the bottom section, is shown in Table A. These formulas govern only when resulting in stresses greater than circumferential tension alone, and/or those from any other possible combination, as noted above.

A graphical comparison of these 4 theories for only 2 principal stresses

Table A

(Summation of Combined Stress Formulas)

Theory	Simplified Formula for Max. Stress	Resulting stress, psi, basis 1½" shell	Ratio Basis Max. Stress
Max. stress	$\frac{pd}{4t} + \frac{M}{.785d^2t} - \frac{W}{3.14dt}$	9,620	1.000
Max. strain	$\frac{pd}{2t} + .3\left\{\frac{M}{.785d^2t} + \frac{W}{3.14dt} - \frac{pd}{4t}\right\}$	9,204	0.957
Max. shear	$\frac{pd}{4t} + \frac{M}{.785d^2t} + \frac{W}{3.14dt}$	11,780	1.225
Mod. strain energy	None—See Text	10,450	1.088

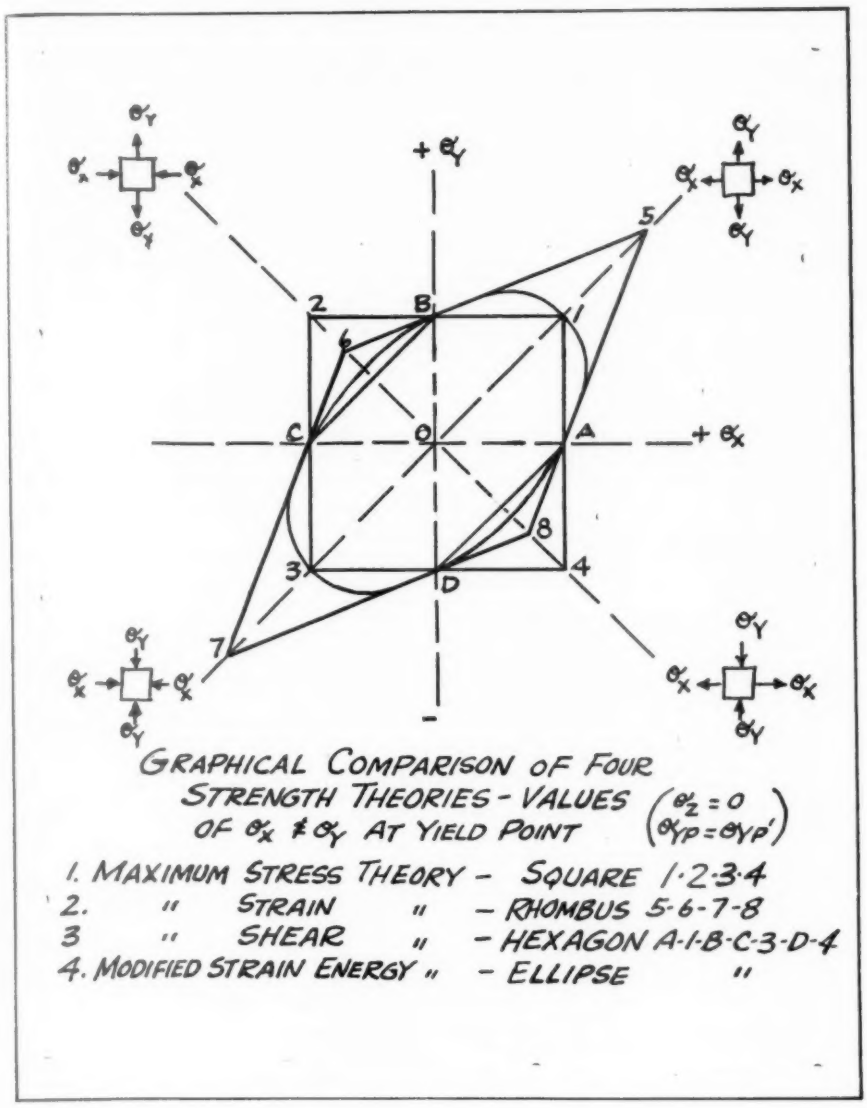
GRAPHICAL COMPARISON OF FOUR
STRENGTH THEORIES - VALUES OF σx ≠ σy AT YIELD POINT (σz = 0, σyp = σyp')
1. MAXIMUM STRESS THEORY - SQUARE 1-2-3-4
2. " STRAIN " - RHOMBUS 5-6-7-8
3 " SHEAR " - HEXAGON A-1-B-C-3-D-4
4. MODIFIED STRAIN ENERGY " - ELLIPSE "

Fig. 2—Graphical comparison of 4 strength theories

($S_z = 0$) and $S_{YP} = S_{YP}'$, is shown in Fig. 2.

For the allowable code stress of 11,600 psi, the summation of actual thicknesses and weights is given in Table B.

The top thickness is governed by the circumferential tensile stress of pd/2t in all cases. The intermediate thicknesses are determined in the same manner as the bottom thickness by computing the smaller seismic moment about the higher points on the shell.

Since this tower has a comparatively high design pressure, the percentage difference in the total weights of the tower shells is not very great. Similar comparative analysis for towers of low design pressures (under 50 psi) often results in a considerably greater variation, however, and as a result the method of calculation assumes greater importance.

In design of tall towers, under low pressure, as well as skirt support plates, elastic stability may be the final design criterion. In order to insure against collapse, the allowable compressive stress may have to be reduced to less than the code stress allowed by the strength of the material. Resistance to collapse in general varies proportionately with the ratio of the thickness to the diameter, i.e., a thin shell of large diameter will collapse under a lower unit compressive stress than a thicker shell of the same diameter, or a smaller diameter shell of the same thickness. For further details on this subject reference is made particularly to Timoshenko's "Theory of Elastic Stability".

In order to avoid disagreements regarding which of the above theories to use, it appears desirable for the proper code authorities to recommend one theory as being preferable to the rest. Pending such action, this question must be decided by the individual engineer or his organization.

Readers are requested to submit comments for discussion to the editor and/or author. All relative questions will be answered in the succeeding issue of NATIONAL PETROLEUM NEWS.

Table B

(Summation of Actual Thicknesses and Weights for Allowable Code Stress of 11,300 psi.)

Theory	Required Thicknesses: Bottom 20′	Next 20′	Next 20′	Top 100′	Weight of Shell Plates	Percentage Max. Stress = 100
Max Stress	1 5/8"	1¼"	1⅛"	1⅛"	290,000 lb.	100
Max. Strain	1¼"	1 7/16"	1⅛"	1⅛"	285,000	98.2
Max. Shear	1 7/8"	1⅜"	1¼"	1⅛"	300,000	103.5
Mod. Strain Energy	1 7/16"	1 5/16"	1 5/16"	1⅛"	295,000	101.8

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The Importance of Soil Mechanics In Design of Compressor Foundations*

General practical considerations that should be taken into account in the design of compressor foundations are discussed, with particular reference to different soil conditions commonly encountered. Types of foundation design are presented and a number of actual installations are described for the purpose of illustrating various problems confronting engineers and plant operators.

By Harry R. Marsh**

THE basic designs involved in the usual foundation requirements for machinery with reciprocating parts, such as those in a compressor, are well established. Reciprocating compressors in general use fall into 3 categories:

1. Horizontal compressors, generally belt driven by horizontal gas engines running at speeds approximately between 160 and 200 rpm.
2. Horizontal direct-connected gas or steam engine drive compressor units, generally gas engine driven, with smaller units of 225 HP and under, operating at speeds of about 200 rpm or greater, and large units up to 1300 HP, operating between 90 and 125 rpm.
3. Some years ago, engine builders came out with a design of direct-connected, gas engine driven, compressor units with the engine cylinders vertical in a single row; or V-type in a double row with the compressor cylinders in a horizontal position on the same frame, and all connected to a common crankshaft. These now are built in sizes up to about 1000 HP. This design was also an advance, in that these machines were built for speeds of 300 rpm or faster.

The first two types of compressor units have been in use over a long period of time. The third type of machine is now in common and widespread use.

The eccentric forces involved in these machines are all more or less of the same character; that is, the forces involved due to the weight or mass of the reciprocating parts moving in a horizontal line, also other directions, are transmitted to the mass of the foundation, which theoretically should be of sufficient weight to overcome these forces. In the older design of horizontal compressor units these horizontal forces were of great magnitude and the foundations of the units for a given horsepower were quite large.

In the later designs, in which the power cylinders were in the vertical or nearly vertical position, the horizontal forces were considerably reduced, as only the compressor cylinder moving parts and some eccentricity due to the revolving of the crankshaft caused horizontal forces which the mass of the foundation had to overcome. This, in addition to higher speeds, materially reduced the foundation requirement and as a result also reduced the cost of the installation.

It is not the purpose to discuss the many things that enter into the computations to ascertain the magnitude of the forces of the reciprocating parts of the compressor unit and the transmission of these forces to the foundation which are peculiar to each machine.

The designer can usually secure the manufacturer's data relative to these horizontal and vertical or angular vertical forces involved for a particular machine; also the manufacturer's recommended minimum foundation expressed in yardage of concrete and a design of foundation which fits the machine involved. The recommendations by the manufacturers on foundations for compressor units are generally predicated on soil having a bearing value of 4000 lbs. per sq. ft. This information as to the eccentric forces involved in the machine selected and the minimum mass of foundation required is the starting point for the engineer to consider in preparing the design of his plant.

Soil Conditions Important

The next step is the consideration of the soil on which the plant is to be built and its mechanics. This is also the point where mathematical calculations become secondary and the engineer's judgment becomes very important.

This is particularly true today, with advances in compressor unit design, in that the machines operate at high speeds, that is, 300 to 350 rpm or faster, and a great deal more work is done with a relatively lighter weight of machinery. This also results in smaller foundations per horsepower unit of the compressor. Incidentally, at these speeds, the number of times of change in direction of movement of the reciprocating parts of the compressor reach a point of vibration approaching that equal to vibration causing sound. These vibrations are transmitted to the soil with peculiar results and, in some cases, with serious consequences.

As no doubt manufacturers are looking forward to the design of compressors of high speeds for this type of machinery, scientific research should be carried out and further studies made regarding this new development with relation to the problem of compressor plant design. Such investigation should be conducted, probably by some representative group of the oil industry's engineering associations and the manufacturers of compressors, collaborating with technical institutions.

The selection of a site for a plant invariably involves many other considerations besides the best soil condition, such as the location of the field, or the route of a pipeline, the location of the plant as nearly as possible on ground that is not subject to flood, and many other considerations too numerous to mention.

Problem for Engineer

It is the engineer's problem, therefore, to design a foundation to meet the soil condition found on the site. The engineer generally has some excavations made, and if not too much is already known of the locality, bearing tests are made on the soil at the level he believes will be best suited to the plant design.

If the bearing tests show that the soil does not yield with a reasonable loading, the weight of the engine compressor unit and the foundation are added and the bearing per square foot is computed and the foundation spread to meet the load that his tests indicate the soil will withstand. The engineer generally allows a safe margin between the point of failure of the soil which his tests indicate and that which he will impose on the soil with the new machinery.

In some cases the owner and engineer have been forced to go into locations that were extremely doubtful in respect to the value of the soil to support the machinery. In those cases, special consulting engineers are generally called in, to make cored borings, soil bearing tests, report their findings, and make recommendations as to the maximum loads that should be imposed upon the site. Again the engineer exercises his judgment and usually allows a safe margin between the reported bearing value of the soil and that which he imposes on it with the compressor machinery.

Foundation Design Principles

Now, we wish to present several simple principles involved in compressor foundation design that we believe are of interest. This discussion will deal with the vertical engine, horizontal compres-

*Presented before California Natural Gasoline Assn., Los Angeles, Sept. 2, 1943.

**Parkhill-Wade, Los Angeles.

sor cylinder, direct-connected type units.

In Fig. 1, the center of gravity of the mass of the compressor and its foundation is in the upper third of the concrete foundation. The center of the crankshaft and compressor cylinder around which the eccentric forces operate, and the center of gravity, are fairly close together. As a foundation is deepened, which is done in some cases to meet a strata of soil of better bearing value, the center of gravity lowers and the distance between the center of the crank and the center of gravity increases. This increases the lever arm, and thus also increases the forces transmitted to the soil at the toe of the foundation, as indicated in the diagram. These forces sometimes exceed the margin of safety allowed by the engineer. This generally results in the compressor and foundation getting in a rocking motion, which is detrimental to both plant structures and piping.

In Fig. 2 another consideration of design of compressor foundations is shown. This is a spread foundation as shallow as possible and as piping will allow. In some cases this spread footing is under the compressors only, and where several compressor units are involved, all are connected together. The spread footing is actually a reinforced concrete mat, generally reinforced top and bottom to take care of negative moments in the concrete slab that might result from uneven soil reaction, and on this mat the concrete is poured, which forms a pad on which to set the compressor. This design accomplishes two purposes: spreads the foundation and materially reduces the soil bearing requirement; prevents the lowering of the center of gravity of the machine and its foundation and lengthens the arm between the center of gravity and the toe of the compressor foundation, thus reducing the soil reaction necessary at the toe of the foundation.

In later designs, the spread footing has been extended in some cases beyond the building wall limits of the plant. Then, the building walls and building also rest on the concrete mat. This increases the mass of the compressor foundation as the weight of the floors, backfill under the floors, building walls and building become an integral part of the foundation. It is interesting to note that in some cases, with these weights added onto the mat, the installation of 600 HP machines resulted in soil bearing under the mat of the whole plant of less than 1500 lbs. per sq. ft. of bearing surface and, in cases of 300 HP units, of less than 1000 lbs. per sq. ft. This definitely allowed these plants to be set on extremely poor soil and yet result in satisfactory operation without any difficulty from compressor unit vibration.

The above discussion and the illustrations are, we believe, sufficient to lead us to the conclusion that shallow and spread foundations are to be recommended, almost regardless of the nature

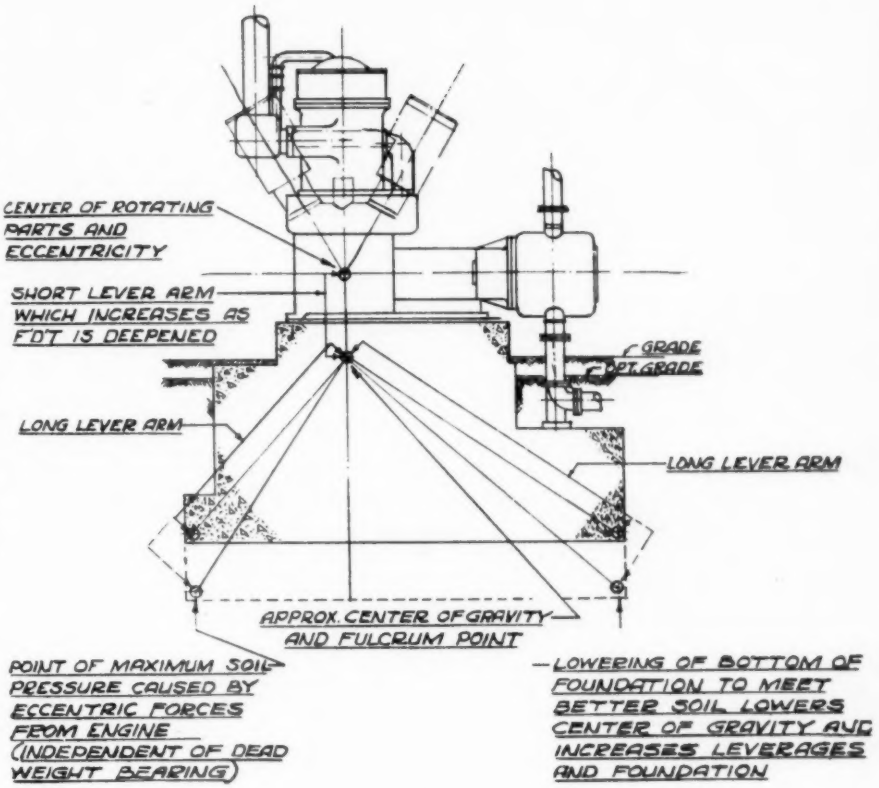
CENTER OF ROTATING PARTS AND ECCENTRICITY
SHORT LEVER ARM WHICH INCREASES AS FDT IS DEEPENED
GRADE
PT. GRADE
LONG LEVER ARM
LONG LEVER ARM
APPROX. CENTER OF GRAVITY AND FULCRUM POINT
POINT OF MAXIMUM SOIL PRESSURE CAUSED BY ECCENTRIC FORCES FROM ENGINE (INDEPENDENT OF DEAD WEIGHT BEARING)
LOWERING OF BOTTOM OF FOUNDATION TO MEET BETTER SOIL LOWERS CENTER OF GRAVITY AND INCREASES LEVERAGES AND FOUNDATION

Fig. 1—Typical compressor and foundation.

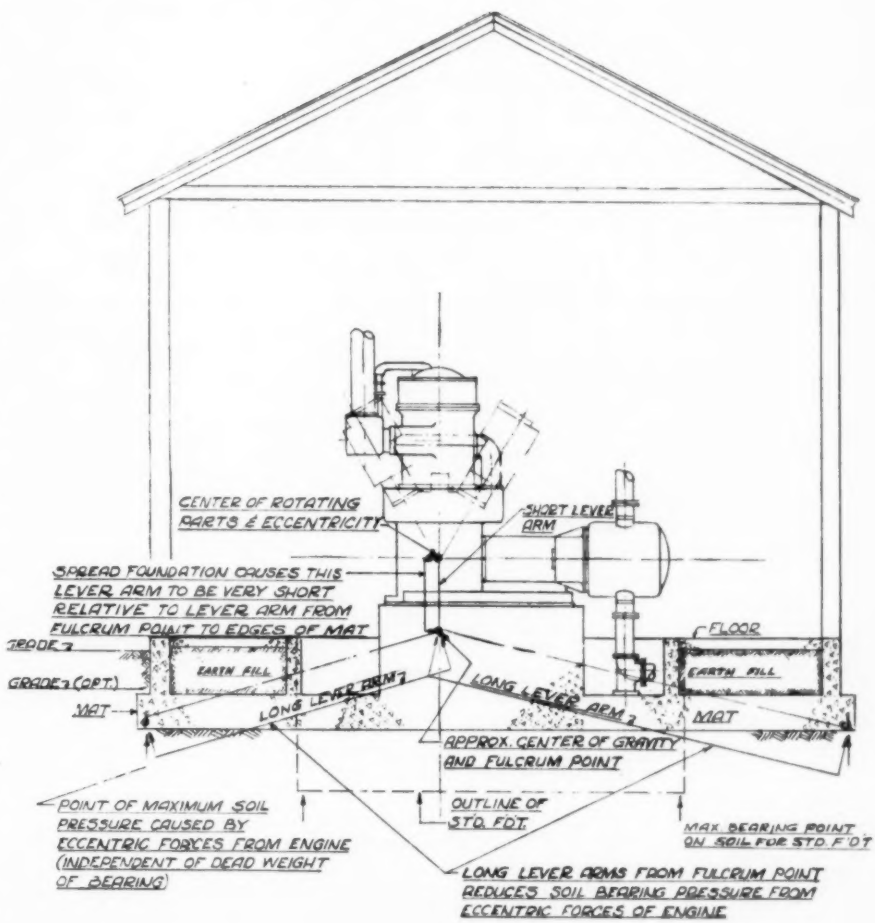
CENTER OF ROTATING PARTS & ECCENTRICITY
SHORT LEVER ARM
SPREAD FOUNDATION CAUSES THIS LEVER ARM TO BE VERY SHORT RELATIVE TO LEVER ARM FROM FULCRUM POINT TO EDGES OF MAT
GRADE
FLOOR
EARTH FILL
EARTH FILL
GRADE (OPT.)
MAT
LONG LEVER ARM 1
LONG LEVER ARM 2
MAT
APPROX. CENTER OF GRAVITY AND FULCRUM POINT
POINT OF MAXIMUM SOIL PRESSURE CAUSED BY ECCENTRIC FORCES FROM ENGINE (INDEPENDENT OF DEAD WEIGHT OF BEARING)
OUTLINE OF STD. FDT.
MAX. BEARING POINT ON SOIL FOR STD. FDT
LONG LEVER ARMS FROM FULCRUM POINT REDUCES SOIL BEARING PRESSURE FROM ECCENTRIC FORCES OF ENGINE

Fig. 2—Compressor on mat foundation.

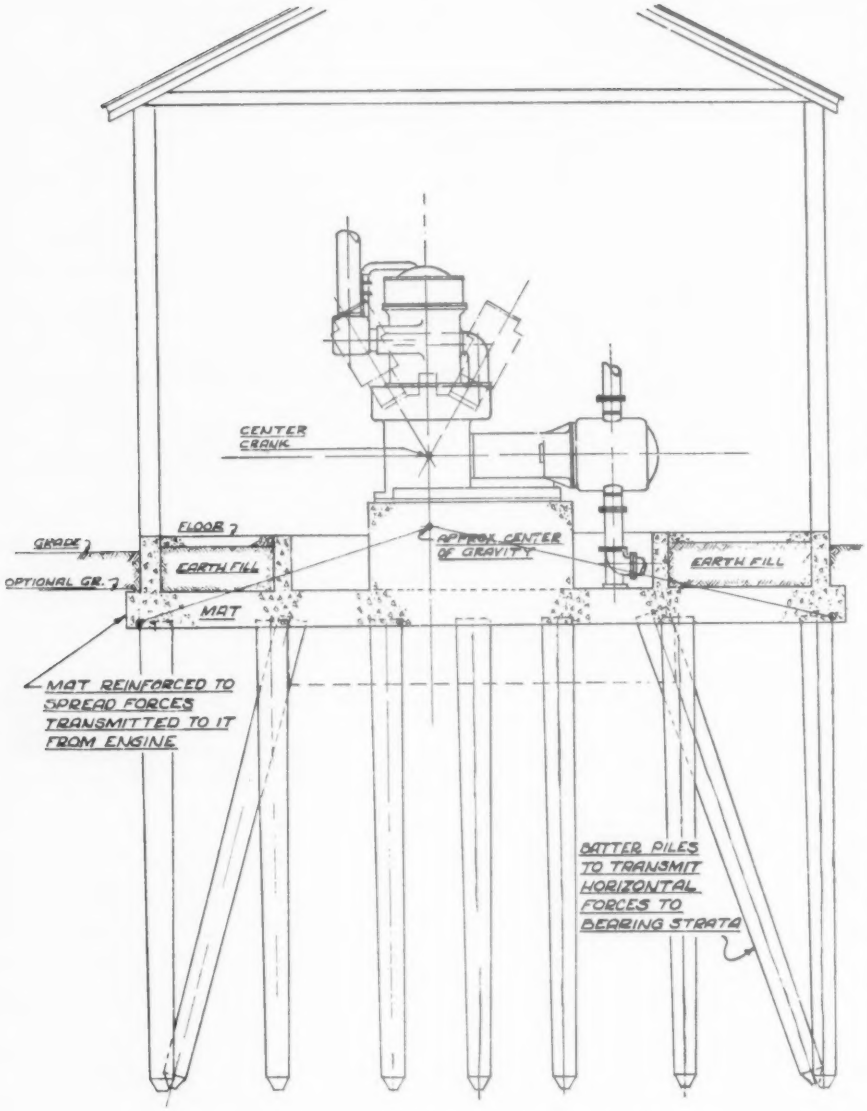

Fig. 3—Compressor on mat foundation supported by piles.

of the soil underlying the plant, except on rock formations.

Conventional Vs. Mat Construction

At this point the question of a comparison of costs is in order. In cases in which the spread foundation has been used and a mat construction installed, the increase in yardage of concrete for the compressor foundation, building foundation and walls, piping trenches, and building floors is less than would be supposed. Comparisons have been made in this respect and it has been found that the increase in yardage of concrete usually does not exceed 15% additional concrete over the conventional design in which the machine foundation, building foundation and pipe trenches are independent of each other.

It is interesting to point out that in some cases in which mat construction has been used, the bottom of the mat that formed the foundation for the plant is at a lesser depth than that called for on the manufacturer's standard recommended foundation drawings. Also, it is interesting to note that these concrete mats were not of great thickness; in cases of large units of 600 to 1000 HP being 15 to 18 in. thick, and on smaller 300 HP units being 12 to 15 in. thick. These mat thicknesses were determined using the standard methods involved in concrete design and keeping within the maximum allowable stress limits for concrete and reinforcing steel.

As the cost of an additional 10 to 15% of concrete is less than approximately 35c per horsepower of compressor capacity, this is a comparatively insignificant addition to the plant investment cost. It is worth such small additional cost reasonably to insure a plant will be free of serious difficulty resulting from inadequate foundation design.

In determining compressor foundation design, soil investigation should be thorough and include investigation for some distance around the plant site. This is particularly so in cases where investigation reveals that clay beds exist at levels satisfactory upon which to place the plant foundations. This recommendation is particularly true where the plant sites are located in valleys over which a stream has varied its course in its geological history. For in these cases, many times, the clay beds are under and sometimes overlaid with sand, gravel, or a conglomerate, and the clay is an alluvial deposit. In these cases the clay beds are sometimes tongues or spits of clay deposited by the stream's action in changing its course, and vary in thickness.

Compressor foundations placed upon this type of clay soil will transmit vibrations through the spit of clay to any other foundation that may rest on this same clay bed. This results in disturbing the other structures.

It is also known that plants which rest on clay soil that is of reasonable thickness and uniform for long distances around the plant, have transmitted vibration to other structures in the same manner. Means of overcoming this difficulty are undeveloped at this time, in so far as the author knows.

Design For Soil Conditions

In swamp locations, or tideland locations, engineers have commonly resorted to the use of piling to support compressor foundations. Here again the mat construction has proved its superior worth over piling-supported, conventional, individual-type foundation design. Where it is necessary to resort to piling construction it is imperative that batter pile construction be used; that is, a number of piles driven at an angle transverse of the center line of the crankshaft of the machines to stabilize or brace the piles that are carrying the load.

As shown in *Fig.* 3, the batter piles are, in effect, diagonal braces for the piles that support the weight of the plant. The material through which the piles are driven not only lacks the ability to support the vertical load but also any horizontal load. Thus in effect the compressor plant is on stilts, so to speak, as the piles are driven until the lower end or tips begin to engage material of sufficient solidity to support the loads imposed upon them. Without the batter piles acting as lateral bracing to transmit the horizontal forces to the strata that supports the plant, the whole substructure of the plant lacks stability. Plants that have been installed on piles without this lateral bracing or batter piling have, almost without exception, been extremely dangerous and troublesome to their owners and the engineers.

The installation of compressor plants on sites which are provided with rock formation as a bed for the compressor foundations are, we believe, relatively scarce. In those cases with which the author is familiar, the foundations of reinforced concrete and anchor bolts have always been designed to be sufficient to insure a monolithic foundation for each machine securely embedded in and grouted to the rock. As this is a most desirable condition, presenting the fewest problems, further discussion of it is unnecessary.

In some cases, compressor plant sites

have been located on sand, or sand and gravel beds. In these cases the conventional bearing test generally reveals that the soil has fairly high bearing value, often from 4000 to 10,000 lbs. per sq. ft. of bearing surface, thereby leading the engineer to believe the plant design problem to be relatively simple. Here the engineer should be particularly careful not to conclude his investigation, but should ascertain the level of the surface water, if any, take into consideration the rainfall of the area, and seek to determine if at any time the ground water reaches a level at or above the bottom of the plant foundations. This is particularly true in case his investigation showed that the plant was to be situated over a deposit of sand, as the inclusion of water in a sand bed will seriously change the nature of the stability of the soil to withstand horizontal forces, and in some cases also the bearing value.

A number of compressor plants that have been built in the usual manner with compressor foundations independent of each other and of building structures, placed on sand or sand and gravel locations, have been observed by the author. In some of these cases where the ground water rose to or above the bottom of the foundations, these compressor plants have been troubled with horizontal movement that was detrimental to the buildings and dangerous to the operation of the plant. This movement was due to the unforeseen stresses that developed in the piping connecting the compressors to the pipeline or other equipment of the plant installation. On the other hand, plants that have been designed using the spread or mat type construction located on sand or sand and gravel beds have not developed this difficulty.

In some areas of the San Joaquin Valley, soil is found with soluble salts throughout it and upon becoming continually wetted had a tendency to dissolve and shrink, thus lowering the surface and, if water comes under foundations, to cause them to drop. Plants located in this type of soil should have carefully provided drainage so that ground water can be prevented from getting under the foundations. The surface surrounding the plant should be paved to turn water from rains and operations and not allow it to seep under the plant foundations.

Case Histories Reviewed

As a matter of interest and illustrating further the importance of the consideration of soil mechanics relative to the design of compressor plant foundations, we will briefly outline a number of compressor plant installations.

In 1930 one of the large interstate gas transmission lines was built. In the first stations 1000 HP twin, tandem, double-acting gas engine, direct-connected compressor units were selected to pump the gas through the pipeline.

The first station of this line was located in western Kansas on a site underlaid with sand. The first installation involved 5 such units. The overall dimensions of each compressor unit foundation were 52 ft. long by 21 ft. wide, and all foundations for the five units were placed upon a 2-ft. thick mat which was several feet wider than the compressor foundations were long. Building foundation was separate from the compressor units. The basement floor between the units was the top of the mat and basement floors were poured and extended from the ends of the compressor units to the building foundation. The operating floor was concrete supported on steel beams, which in turn were supported by the compressor foundation and the building walls and foundations. This construction proved satisfactory, and in this particular plant no trouble developed from this selection of compressor plant foundation design.

Another compressor plant on this pipeline was located in west-central Missouri on a site underlaid with solid rock. At this plant the foundation situation was ideal, the main construction job being the blasting and cutting away of the rock to the proper level to allow for the full basement design that was used in these plants.

These plants have been added to since, over a period of some years, using the same construction, and both have operated satisfactorily.

In another gas pipeline system extending from Louisiana up the Mississippi River Valley, the original compressor plants were built in 1927. These plants were constructed using the design of individual foundations for each horizontal 1000 HP compressor unit, the units being independent of the building foundations.

These compressor plant sites were located in and near swampy territory and on very poor soil, made up mainly of sand with thin layers of clay, and with ground water within a few feet of the surface. Consequently the engineers chose piling driven about 20 to 25 ft. to a strata of firm clay or soil. When these plants were started there was some horizontal movement of these machines and bases, which was not serious. The operator also slightly staggered the speeds of these machines to prevent their getting "in step," and thus reduced the magnitude of the horizontal movement.

These plants operated over a period of about 10 years, at which time additional compressor facilities were necessary for this pipeline. Up to this time the small horizontal movement of the machines and their foundations on the piling had not been serious enough to cause any damage to the plant or cause undue alarm. However, this movement was transmitted to the piping, which was buried underground and connected to atmospheric type gas coolers located in the cooling towers. An observer, standing on the top of the tower, could easily feel a sway in the cooling tower, which was in rhythm with the speed of the engines.

In one of these plants two additional vertical gas engine, horizontal compressor cylinder, angle-type compressor units were installed on a concrete mat in turn supported by piles, the rotation of these additional units being transverse to that of the horizontal 1000 HP units. This tended to stabilize the whole compressor plant in a rather peculiar fashion. The end of the compressor building in which were located the angle-type machines was practically free of any horizontal movement, but the horizontal movement of the plant was progressively greater toward the other end of the building which contained the four 1000 HP compressor units. Since the installation of the first two angle type machines, additional angle type machines have been added to the plant, and the horizontal units, through an expensive construction operation, have been placed upon a common concrete mat.

In 1937, on this same pipeline, the first large size angle-type compressor units were installed. This consisted of five 600 HP compressor units. The plant site was in a particularly swampy area about 20 miles from the Mississippi River which, before flood control had been effected, would seasonally be under 6 or 7 feet of water. Soil investigation of this site revealed that it was a sand and clay, river deposited alluvial soil, with very poor bearing value. In this particular area investigation revealed that buildings and bridges were universally set on 20 to 25 ft. piling, which developed a bearing value of about 15 tons.

The engineers who started the project decided upon mat construction consisting of a thin mat 15 in. thick, reinforced top and bottom, placed approximately 1½ ft. below the existing grade, on 20 ft. piling about 5 ft. centers, with the floor of the compressor plant 2 ft. above the grade; this to place the operating floor above the highest water level that was anticipated during flood stages and to allow the piping to and from the compressor cylinders to come out through trenches which were below the floor yet above the compressor mat.

The data from the manufacturer of these units revealed that the horizontal forces of these particular machines were extremely small and, with the building, building walls, trench walls, floor and backfill between the top of the mat and the floor, provided a mass that was far in excess of that necessary to absorb the forces created by the movement of the reciprocating parts of the machines. This plant was located on a 10-acre site on which were situated 5 dwellings. No vibration of even the slightest degree was noticeable near the compressor plant, nor at any point on the 10-acre site.

An interesting feature of this plant was the installation of a 200-kilowatt multi-cylinder gas engine driven electric generator unit, operating at a speed of 412 rpm, which was standby to electric services furnished to the plant by an outside power company. This unit was placed on a foundation built exactly in accordance with the manufacturer's

drawings and placed on 6 vertical piles, which was more than sufficient to take the load imposed upon them. At any time that this generator unit was started it set up a vibration that could easily be felt in any part of the plant and as far away as the houses on the 10-acre site. It was believed that if this installation had been set on six piles driven at an angle, as batter piles are, this condition may not have existed.

In Mississippi on this same line, another plant was constructed using the conventional horizontal 1000 HP compressor units. Preliminary investigation, done through the summer months, showed that this plant was located over a deep sand bed. Engineers in charge of the project decided upon piling to support this plant in which each foundation was individual. In order to illustrate the compactness of this sand bed, we will remark that the piling had to be steel tipped and the butts steel ringed in order to withstand the stress that was placed on them in driving through the sand, and a great deal of difficulty was experienced in the work of driving the piles.

In the fall, when this plant was ready for operation, the ground water had risen considerably and when the plant was started the horizontal movement was so great that the plant was not safe to operate due to the stresses imposed upon the piping.

The building movement also was so great that bolts in the building framing were broken and sheared. This difficulty was overcome after a good deal of lost time in the operation of the plant and great expense involved by excavating under the compressor foundations, installing steel diagonal bracing on the piling, and refilling the burrow or cavity under the units by pumping concrete into it.

In 1938 two small compressor plants for high pressure recycling operations were built in the rice flats between Beaumont, Tex., and the Gulf of Mexico. These sites were 4 ft. above sea level and soil tests and the experience of the oil companies in that location indicated a serious foundation problem for these plants. In this locality it was the practice to place oil well derricks on wooden mats made of 3-in. x 8-in. x 20-ft. long timbers laid in transverse layers forming a mat 20 ft. square under each derrick leg. In the wet season the whole area was virtually under water and the top soil consisted of a very sticky muck; in the dry season ground water was within 18 in. of the surface. The placing of piling was extremely costly as 65-ft. piles developed extremely low bearing value.

After considerable investigation it was decided to design these plants using the mat type construction. Calculations indicated that the dead weight bearing of the building, backfill underfloors, and floors which were to be 2 feet above grade, and the compressor unit would impose a load calculated to be 854 lbs. per sq. ft. of bearing surface under the mat. After careful consideration this design was adopted. The compressor units were 300 HP size and had considerable horizontal forces involved. On the completion of these plants and the starting up of the units, this selection of foundation design proved to be very successful.

In 1940 a compressor plant consisting of 300 HP angle-type units were installed within a mile of the Delaware River in a refinery that bordered a city; in fact dwellings were located much less than a city block from the compressor plant site. As considerable refinery apparatus had been successfully installed adjacent to the proposed compressor plant site, soil investigation for it consisted of excavating to the required depth, ascertaining that there was a compact clay deposit greater than 6 ft. thick under the proposed foundation, and that the bearing value was in excess of 4000 lbs. per sq. ft. A compressor mat was designed to support all the compressor units and their foundations and, using this design, the installation was completed. On starting this plant, vibration developed that was transmitted through the clay beds to those structures that rested on it and over it.

Valuable Experience Gained

Another plant was subsequently built, having four similar 300 HP units, in which the total weight of the engines plus foundations equalled 750,000 pounds, and was carried on coil springs using flexible joints between the moving mass and the earth.

Experience gained from these plants and from additional studies of the subsurface soil formation at this location has led the engineers to select piling to bedrock plus batter piles as the best solution for this problem in this particular area. At this time two plants, one of 1625 HP and the other of 2400 HP, are now under construction using the method of piling to bedrock plus batter piles to support them and give the plants stability.

In 1942 a plant was designed and built at a location in the San Joaquin Valley which was very near a small river and located on more or less swampy alluvial soil. Special consulting engineers were engaged, who made their investigation by core borings and bearing tests. They recommended foundations be either carried on piles, or where not on piles, that the loads imposed on the soil be not greater than 1200 lbs. per sq. ft. of bearing surface. In this case the engineers decided to use the mat type spread foundation design in view of the nature of the soil, and to forego using any piling to support the compressor plant including its cooling tower installation.

Practically no excavation was made at all, only that sufficient to scrape off windblown soil and present a level surface on which to pour the mats, and a fill 2 ft. in depth was made over the original grade to bring the operating level near that of the floor of the compressor building. The building was of reinforced concrete and brick, with steel truss and corrugated asbestos covered roof, which is heavier than the usual type construction. This, together with the compressors, was all supported by the mat. When the backfill was completed and all the work done, the surface of the yard was carefully graded to drain and macadam surfaced so that all water would run off the site. On completion of the construction work the plant was started and this foundation design in this plant has proved to be very successful.

A large new gas cycling plant has just been completed in Texas, in the Gulf plains near the city of Houston. The location is very flat and surrounded by rice fields, which primarily account for a water saturated soil 4 to 5 months of the year. Natural rainfall accounts for a semi-saturated condition the remainder of each year. The top soil is black sandy loam, then a layer of very fine sand which resembles quicksand, and under that a very dense non-porous clay, which is believed to be quite extensive in the area. It is on this non-porous clay that the engineers decided to place the compressor foundation mat. The compressor mat is 32 ft. wide by 196 ft. long. The maximum thickness of the mat is 20 in. and tapers to 8 in. thick, with a 12-in. retainer curb extending the complete length of each side of the mat, with the main reinforcing in the bottom and some reinforcing in the top of the mat. There are 7 angle-type gas engine units of the V-engine type installed in this plant.

When this plant was started some vibration resulted. However, the compressors are extremely stable and as the piping supports are integral with the compressor mat, the problem of the vibration is believed to be negligible.

All the equipment of the cycling plant is also based on this same clay strata, and some vibration is transmitted to this equipment and structures, but not of serious proportion. Again, in this case, we find that clay has the characteristic of transmitting vibration considerable distances.

Ways to Damp Vibrations

Other interesting and somewhat novel methods have been tried to isolate compressor units and their foundations from the compressor mat or substructure and thus prevent transmission of vibrations. One novel method tried was the use of felt, but in these cases the movements of the machines were so great that it was impossible to keep flexible piping joints in service continuously. Also evidence of eventual complete deterioration of the felt was discovered, which discouraged the engineers conducting this test from continuing this line of investigation.

Another partially successful method of reducing vibration from compressors is the work of control of speed of the engines by synchronizing the machines in such a manner that they do not get "into step". However, in this investigation, the instruments used were experimental and constructed of materials which failed to stand up in continuous operation, and

the engineers were justified in not going further into this development or replacing the instruments with better ones because of wartime conditions. It may be that at some later date this work can be resumed.

Another method used to dampen compressor machinery vibration has been used in a refinery located on tideland, in which all of the plant, except the compressors proper, was placed upon tiling. In this case a box-type spread footing was designed to receive the compressor foundation, the box being of a size equal to the minimum mass of concrete recommended by the compressor manufacturer. The box side walls were lined with 1 in. of cork board, and on the bottom several boards of cork 1½ in. thick by 12 in. wide were laid in accordance with the recommendations of the manufacturer of the cork, which took into consideration the weight of the machine and the anticipated vibration from it. Over these boards were placed ¼ in. thick steel plate strips the same width as the cork strips, and on that corrugated iron was placed to act as a form on which to pour the concrete foundation within the four walls of the box.

This installation was operated over a period of several years and proved to be satisfactory. Further observation of this unit over a longer period of time is necessary to show that this method of dampening the vibrations will be successful during the life of the plant. However, all indications are that it should be successful. This conclusion is further confirmed by the fact that cork board in confined steel pans successfully dampens vibration of reciprocating machinery in buildings of reinforced concrete design. This type of installation has been successfully used over a long period of time and indicates that cork board retains its resilience over a long enough period of time to warrant its use in this manner.

Another serious compressor plant problem, particularly in high pressure plants, is the vibration of piping. Piping vibration of serious proportion in high pressure plants is related to the reciprocating action of the compressor, in that the reciprocating piston in the compressor cylinder and the passage of the gases intermittently through the valves causes a pulsating flow and resulting pressure waves of the gas in the piping. Because these gases are dense and particularly heavy they have a "hammer" action, thus causing the pipe to vibrate. We believe it is unrelated to vibrations set up by the reciprocating action of the moving parts of the engine and the compressor—which forces are transmitted to the compressor foundation—except that they both originate from the same primary sources and are parallel in their rhythm or timing.

In conclusion it is apparent that for each installation the design of compressor foundations and their relation to the mechanics and reactions of the soil on which each plant is to be built present individual problems, and that the solution for each necessarily must take into consideration many factors.

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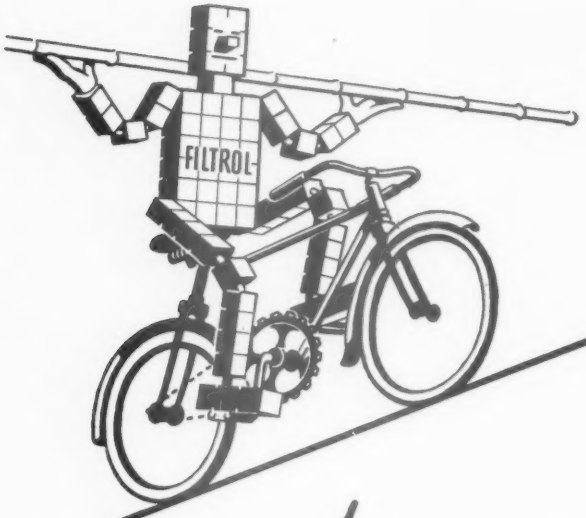

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BOOK REVIEWS

First of Two Books On Adsorption

"The Adsorption of Gases and Vapors", Vol. 1 on "Physical Adsorption", by Stephen Brunauer, is a scholarly treatise on a phase of science of growing importance. Rather than approaching the subject from the more practical standpoint of the properties of various important adsorbents, the author treats it as a branch of physical chemistry.

The author is a chemist in the Bureau of Plant Industry, U. S. Department of Agriculture, Washington. He says of this work: "Had I started writing this book a year later, I would doubtless have adopted the more practical approach (properties of adsorbents) because of its more direct relation to the needs of the war industry, but on the day of Pearl Harbor the greater part of this book was already written."

Adsorption has long been of intense interest to refining technologists because it is believed the phenomenon plays an important part in the mechanism of catalysis. Its application in the refining of many petroleum products by clays is extensive. The possibility of catalytic desulfurization of crude and refined products is now receiving much attention.

The first volume is restricted to a discussion of physical adsorption. The second volume, projected for future publication, will deal with chemical adsorption.

There are two indexes: author and subject. Footnotes appear at the bottom of the page for ready reference. There are 497 pages of text. The book may be purchased through the Book Department of NATIONAL PETROLEUM NEWS for $7.50, postpaid.

AIME Transactions

"Petroleum Development and Technology" (1943), the official transactions of the Petroleum Division of the American Institute of Mining and Metallurgical Engineers, is the 18th of the series, and contains papers and discussions presented before the Division at meetings held Feb. 9-12, 1942, in New York; Oct. 15-16, 1942, in Los Angeles, and Oct. 29-31, 1942, in Austin, Texas; also the petroleum statistical reports covering 1942.

There are 6 chapters devoted respectively to production engineering, engineering research, geophysical exploration, petroleum economics, production and refining. The book, 601 pages, bound in cloth, sells for $5 and can be secured from A.I.M.E. headquarters, 29 W. 39th St., New York.

Technical Section, NATIONAL PETROLEUM NEWS

Published Every Month by

The National Petroleum Publishing Company

Publication Office, 1213 West Third Street, Cleveland 13, Ohio, U. S. A.

V. B. Guthrie, Editor, Technical Section • D. P. Thornton, Jr., Assistant Editor

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√ CHECK THE ADVANTAGES OF AIRETOOL...

√... TUBE CLEANERS

Airetool's unique power seal motor gives 28% greater power. It is ruggedly constructed and yet its precision slip fit construction permits speedy maintenance. Motor starts immediately and can be loaded down to 50 rpm without stalling. The new form cutters remove deposits in tubes quickly and thoroughly without tracking or damage to tubes. Airetool Tube Cleaners are available in sizes ½" to 20" I.D.; for straight or curved tubes; in a variety of combinations to meet any coke problem. These advantages mean faster cleaning jobs and less down time.

√... TUBE EXPANDERS

Airetool Expanders have been developed to meet the demands of modern oil refinery technology for properly rolled joints. Airetool's construction of the best alloy steels and expert workmanship assures a longer life than similar tools. They are flexible and easy to use. A wide variety of sizes and designs are available to meet every tube expansion need.

√... REFINERY SPECIALTIES

Airetool also manufactures time and labor saving Flycutters, Combination Boring and Cut-Off Tools, Heat Exchanger Bundle Cleaning Lances, Pistol Grip and conventional Calipers, Buffing Motors, Polishing Motors, Tube Jigs, Tube Gauges and others.

WRITE FOR BULLETIN WHICH EXPLAINS AIRETOOL CLEANERS, EXPANDERS AND SPECIALTIES IN DETAIL.

AIRETOOL MANUFACTURING COMPANY

433 SHUEY BLDG. SPRINGFIELD, OHIO

TESTED OK
Wyatt's